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FACILITY TECHNOLOGY

catalyst for learning

EF003215

ELEVEN SELECTED PRESENTATIONS FROM THE
FORTY – FIFTH ANNUAL CONFERENCE – 1968
COUNCIL of EDUCATIONAL FACILITY PLANNERS

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Foreword

"...the schoolhouse as we know it is obsolete. The tasks and the opportunities of education are far too great ever again to be confined within any single enclave designated as a school."

As these words from Dr. Fischer's keynote address infer, facility planners today face a monumental challenge. Specific answers to the educational challenges of the next several decades, through the disciplines of architecture, comprehensive educational planning and facility administration, will have a dramatic influence on not only how well our children are educated but also on the future of education itself.

The geometric curve of knowledge has, and will continue to, project itself at an increasingly steeper angle in relation to our capacity to impart the knowledge. Tomorrow's citizens will hardly be prepared to cope with the twenty-first century unless this generation begins to make some significant improvements in both facilities and methodology, if it is not too late already.

This forty-fifth Annual Conference of the Council was held in Washington, D.C., October 7 through 10, 1968. Its theme: "Facility Technology — Catalyst for Learning." The Council wishes to express its appreciation to the many individuals whose contributions and efforts, both before, during and after the conference, made it successful and significant.

Much of the stimulation of the Conference could not be put onto a printed page — the informal discussions, the architectural exhibits, the "kaffe klatch" conferences, all were a part of the Conference too.

In retrospect, however, we are disturbed more by our weaknesses than we are encouraged by our strengths. As we probed, session by session, into the dramatic technology of educational and facility hardware, it became more and more apparent that we lacked the programing, the content, and the ability to utilize what we had and

what could be produced for us. The gap between the art of education and the science of its implementation is wide indeed.

This book presents many of the outstanding presentations given to the Conference participants. Individually, they are pointed contributions to any facility planner's scope of thinking; collectively, they present something more than the sum of the parts — a program for tomorrow.

Unfortunately, tomorrow is almost here.

Dwayne E. Gardner
Executive Secretary

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DR. JOHN H. FISCHER
President
Teachers College, Columbia University

Facility Technology: Catalyst For Learning

Let me begin by admitting what some here already know and the rest would soon discover. To talk with any authority at all about facility technology is quite outside any competence I possess. In other company I might be tempted to brazen it out, but not here. But **Facility Technology, Catalyst for Learning** is the topic assigned to me. As I understand, it is also the theme of the conference and so I dare not ignore it altogether. Instead of speaking on it, however, I shall speak about it. Approaching from several directions, I shall try to encircle what I cannot hope to encompass, and so if I do not directly touch the subject I shall try to illuminate it as best I can. Then I shall leave it to you and your expertise to spell out during the remainder of your sessions the catalytic effect of physical facilities on the learning process.

Seriously, my intention is to deal less with facilities than with learning, to consider with you the character of the contexts in which learning occurs and by which it is influenced. For my purpose this evening it is fortunate that you are no longer the National Council on Schoolhouse Construction, for I am convinced that the concept of a schoolhouse, as the place where all really worthwhile education occurs, is seriously obsolete. Moreover, if we try to restrict education to it, the schoolhouse will become worse than obsolete, it will become obstructive. Therefore, instead of talking about schoolhouses or even the broader category of educational facilities, I shall examine some of the forces by which the processes and the means of education are now being influenced and to which they must respond. I shall deal with these forces in two groups: first, those that are generated within the whole of society and affect mainly what and why we learn; and, second, those that flow from our growing knowledge of learning and communication, that help us understand how learning occurs and how it can be aided.

The most pervasive and powerful fact about education today is that in every aspect of human affairs the systematic development of intellectual capacities has become imperative. Half a century ago Whitehead warned us that "the race that does not value trained intelligence is doomed" and every day new evidence supports the accuracy of his prophecy.

The idea that the enlightenment of the people is fundamental in a free society is hardly new. We Americans have been saying it for some two hundred years. But what is new is that in the modern world that statement is more than rousing oratory or the stuff manifestos are made of. Today we know that the country does, in fact, depend on its educational system. In a quite different sense that the phrase has customarily been used, education has indeed become compulsory — not merely for pupils, but for people. The evidence is undeniable: Where education declines, the community is diminished. Where learning is not promoted, the nation remains under-developed. Education is no longer safely regarded as a privilege of the elite or as an optional form of charity for the poor. Effective, relevant, universal education has become a condition of national survival and the indispensable means to social, political, and economic progress.

This new sense of education's significance is by no means limited to the level of public policy. As a family concern, which it has always been among the more advantaged, education has now become a matter of imperative urgency everywhere. Parents who are resigned to their own limitations vigorously demand for their children the opportunities they were denied. They know that education is more than a ladder to material attainment. It has become the gateway to freedom and they will not see it closed to their children.

Two years ago the Educational Policies Commission, in a report entitled *Education and the Spirit of Science*, made the point that even more significant to mankind than the tangible results of scientific inquiry and techno-

logy are the values and modes of thought on which science depends. These values and the rational processes associated with them, the Commission reminded us, are now permeating the entire world.

These values the Commission identified as:

1. Longing to know and understand
2. Questioning of all things
3. Search for data and their meaning
4. Demand for verification
5. Respect for logic
6. Consideration of premises
7. Consideration of consequences.

These values are acquired not through indoctrination but through inquiry, experience, discovery and reason. They are, to be sure, fundamental to the formation of scientists, but they are also the underpinning of productive thought and wise judgment in every field.

Let me quote one paragraph which epitomizes the Commission's observations and its argument:

"If a single word summarizes the various characteristics of the scientific spirit, it is awareness—awareness of the uncertainty of man's knowledge—awareness of the extent to which the self influences one's perceptions, awareness of the consequences of one's values and actions, awareness of the painstaking modes of thought which have enabled man gradually to develop his knowledge of the world. This awareness is the basic stuff of freedom; only insofar as a man is aware of the influences upon him can he filter them and become himself and only insofar as he is aware of the problems and modes of knowing, can he help himself and others to understand the world."

But for all their indispensability, science and technology have brought burdens as well as benefits. One result of the revolutions in agriculture, industry, communication, and transportation is that cities everywhere have burgeoned. Millions upon millions of people, some with high hope and others hoping merely to survive, turn to the metropolis to meet their needs. But too often they meet only submergence in a faceless, formless mass of a life characterized increasingly by collective action and collective compulsion, a world in which it becomes harder and harder for a man to find his own soul. Under these conditions it is scarcely surprising that men want new ways to assert and express their individuality. This is the circumstance that explains in large part the vigorous efforts of sensitive and perceptive young people to break out of the herd, to do their own thing, to prove that they cannot be compelled to conform. The search for individuality has always been a powerful part of the drive to learn, but in the modern world that search takes on new meaning. The energy and the purpose behind it must be taken into account by anyone concerned with the process of learning or the means for furthering it.

The search for individuality gives rise to its natural complement—the search for community. For it is only in community that individuality has meaning, only in association with other human beings that any man truly fulfills his own humanity. The necessary alternative to the effects of mass production, mass treatment, mass living, and mass communication is a community built to the scale of a man and his family, a system of association in which it is possible really to identify common concerns and to work in concert toward their attainment, supported by the security men of good will can give each other. Education must therefore be directed not only toward enabling man to become his best self, but equally to helping him to find among his fellows the nurture that integrity can gain only from plurality. The response to urbanism, to bureaucracy, to overcentralized education, is not to destroy the organizations that frustrate us, but to redesign them to promote the integrity of persons rather than to preserve their processes as though they were most important.

Closely related to the search for social and political community is the universal effort to find cultural identity. For over a century we subscribed to the belief that the twin purposes of American public education, indeed of America itself, were to give everybody his fair chance and simultaneously to meld all our differences, our often discordant differences, into a common American culture. Frequently we acted as though equality required homogeneity. But despite our best efforts—and our worst—difference did survive. Regional, national, religious, and racial diversity still continue if to a lessened degree to characterize the country. Now it is not the public school but other forces that threaten to obliterate the distinctions among our cultural attachments. To some the threat comes from mobility and the mass media. To others the danger lies in punitive prejudice and public policies that ride roughshod over local interest and preference.

When black citizens insist that their culture, their history, their identity not be disregarded, their behavior is in a time-honored American style. Our fellow citizens in the black ghetto are demonstrating only their version of what many other groups in our society practice in their own ways. The celebration of St. Patrick's Day was not, so far as I know, invented in Missouri, but are Irish-Americans on that account to be faulted for honoring the seventeenth of March? Or the Greek community for teaching their children the language of their forebears? The search for individuality and the search for community are both supported by the drive for cultural realization. It is the particular obligation of educational institutions and agencies to recognize this force and not only to respect it, but in every possible way to cultivate it.

A second group of influences bearing upon the educational enterprise and influencing learning flow from other sources. They stem from the disciplines that illuminate the processes of learning and development, and from the technologies that facilitate those processes.

When we think about the knowledge explosion, we ordinarily associate it with specialization in the traditional disciplines and the new sciences that are spun off by older fields. To be sure, knowledge expands outwardly as separate lines of inquiry are extended further and further into what was once the unknown. But the figure of longer radii and more of them does not fully diagram the growth of knowledge. Between the radii, a network of interconnections is taking form. Significant frontiers of investigation lie between the disciplines. As a consequence of work in these interstitial areas, the differences between the disciplines are far less clear than they once were and their interdependence steadily increases. It is no longer possible to state precisely where the domain of

chemistry ends and that of physics begins. The lines that used to separate the subdivisions of the life sciences from each other have become gray areas. For the psychologist to pursue his inquiries fruitfully today he must enlist the help of the bio-chemist, the bio-physicist, and the endocrinologist. Even the once wide gap between the humanist and the scientist is being bridged. The modern historian is handicapped unless he can work with anthropology, sociology, and even in some cases, advanced mathematics.

The big word on campus today is relevance. It is used more and more by students who are not satisfied simply to pursue knowledge for its own sake. Unfortunately as we use the word today it suggests mainly the connection of research and teaching to current social problems. The issues of academic relevance cannot however be limited to a single current dimension. Every effort to attach meaning to a new discovery, or to find new meaning in a familiar fact reveals new evidence also of the relevance of the disciplines to one another. The result, obviously, is that the problems of learning and teaching become both ever more complex and more demanding. Any technology intended to further either teaching or learning must take account of this web of interconnections among the fields of inquiry.

More systematic investigation of the ways in which learning can be facilitated and human capacities released is steadily adding to our knowledge of the phenomena of growth and learning. In no area are the gains more promising than in the enlarged understanding we are obtaining about early childhood. Steadily accumulating evidence shows that the years from birth to five are crucial to the entire span of a person's life. It also suggests that if some phases of development are inhibited or inadequately nurtured, the result may be much more serious than a mere delay in reaching successive stages of maturity. In some cases early deprivation may arrest development permanently and thus produce effects beyond later correction.

The pedagogical implication is that delaying a child's systematic instruction, or even restricting his informal learning, until he is five or six may handicap him for life. There is little doubt that at the very least a child so deprived suffers a lasting disadvantage compared with one whose first formative years are lived in culturally abundant surroundings.

The new evidence of the effect of the cultural environment on human development has demolished the easy assurance with which educators have customarily classified children as innately dull, average, or bright. While it remains reasonably certain that human potentiality does vary at birth, we can no longer assume as confidently as we once did that differences in school performances reflect primarily qualities that are inborn. How and how well the child performs, how effectively he learns, how readily he takes to learning, we now know to be attributable in large measure to the circumstances and opportunities he encounters after he is born, and not least to the sensitivity, perceptiveness and professional competence of his teachers and the people who manage his learning.

The generalization before which all of us must maintain a decent humility is that our knowledge of human capability and the ways in which it may be released and cultivated is still very small and the possibilities very great, indeed.

A third field of rapid development about which many of you are far more knowledgeable than I, has to do with the dramatic increase in technology revealed in the new mechanical and electronic devices for storing, organizing, retrieving and disseminating information. Here the challenges to all of us can only be called staggering, and we shall do well to remember that we are dealing here with much more than ingenious additions to the traditional kit of teaching tools.

To project, for example, what the availability of the computer might ultimately mean to the functioning of the human brain, one can begin by considering how intellectual productivity is altered merely by the availability of a pencil and a sheet of paper. The presence of pencil, paper, an alphabet, and numerals changes the brain itself not at all, but it increases very significantly what a man can produce. If so relatively simple a device can lead to such impressive consequences, how shall we envision what a sophisticated computer might contribute to the brain's utility? What we confront is a new order of symbiotic relationship between man and instrument. It not only offers man a longer lever by which to apply his mind to his work, but the possibility of releasing mental capabilities that are rarely, if ever, tapped.

The most difficult of all the questions the new technology presents is that of mustering the ingenuity and the imagination to organize men, machines and materials into productive and effective systems that will use the new knowledge and the new devices to respond to the old and new influences that motivate us to learn.

As I said at the outset, the schoolhouse as we know it is obsolete. The tasks and the opportunities of education are for too great ever again to be confined within any simple enclave designated as a school. To be sure, we shall want shelter while we learn, and we can assume that we shall want specified learning centers for certain purposes and at certain times. But it will not be enough that the internal partitions of these centers be movable. Their external walls must also be permeable. Nor will it do for teachers and others in the school merely to be organized as instructional teams, although we shall certainly need better rationales and patterns for deploying the human facilitators of the learning process. Those who work within the physical confines of institutions will have to see themselves as part of a broad context, a wide and inclusive system for stimulating and aiding learning. That system of men and devices will extend through the community, through the nation, across the world, and into space. It will reach not only to the orbits of our present communication satellites but on beyond them into the universe itself.

Yet, however widely the network extends, however intricately it is engineered, its utility, its effectiveness and its efficiency for education will ultimately have to be appraised by a simple criterion. How well will it enable the individual human being to make the most of whatever he has it in him to become? Will it help a man better to find his own soul? These no less than the problems of engineering and invention, are the issues to which we must respond. ■

MR. RICHARD L. SHETLER
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Technology And Hardware Systems

The topic assigned for this session, **Technology and Hardware Systems,** appears to be an open invitation to the participants to describe in detail the philosophy, the construction, and the circuitry of their own favorite brand of educational machinery. Even better, it might be an opportunity for an expert to expound on an accepted interlocking family of theorems and proofs that encompass a field called educational technology. To describe the embodiment of this technology in a hardware system, even under the most rigorous form of validation, shows that most learners undergo a learning experience when motivated or induced to proper involvement.

Now, here is the catch. No one knows what the proper involvement is, because no one really understands what the learning process is. On one hand, we have those who believe that learning has occurred when a desired behavioral change manifests itself. I call this a conditioned reflex syndrome. On the other hand, we have those who believe that learning is a subjective blossoming of latent capacities, the very existence of which separates man from beast.

I am not so profound as to take sides in this matter. Nor do I believe that good educational technology can always be embodied in the hardware of education; hence, I will not risk devising a machine and then seeking means to justify its use in the learning process. The woods are full of educators and engineers who have done just that and they may have developed solutions for problems which do not exist.

Instead, consider that good educational technology is the art, the lore, the science, and the teacher, and that books, films, projectors, and yes, even computers are just physical trappings used by the teacher in practicing that art, lore, and science.

In considering educational technology as the all, the everything of education, (note I say education, not learning) let us explore a bit the scene of this meeting. **Facility Technology-Catalyst for Learning** is an apt topic because we have in our schools a vast quantity of ingredients, including knowledge and skills of many kinds to be mixed with a wide variety of human minds. We want the resulting product of this mixture to be educated and useful citizens. In the past, we considered the teacher as the chemist who did the mixing. He was given components and, by time proven procedures, combined these vast quantities of ingredients with the hope that the resulting mixture would be students who carried away some measure of the knowledge and skills into which they had been immersed. Some students' minds mixed well with the knowledge and ingredients and they became well educated scholars, scientists, and businessmen. Some minds didn't mix with the knowledge and ingredients and they simply stopped going to school and helped fill the need for laborers and unskilled manpower.

Today there is little demand for the unskilled and untrained, and the dropout becomes the disadvantaged, and often, the disenchanted. Educational hardware may be just the catalyst for educational technology that is needed so that the handicapped, the disadvantaged, and disenchanted, and the students with inherent learning difficulty can be helped to learn what they must learn to be useful citizens.

Here, let me make just one footnote about economics. In chemistry, the catalyst enables a reaction to take place without itself changing. This makes it economically feasible to use expensive materials like platinum as a catalyst for making compounds which must be low in cost. The platinum in chemistry can be analogous to the hardware in educational technology. The hardware, if properly selected, can bring about great changes in the educational process producing useful citizens at a relatively low cost. Moreover, the hardware will remain just as valuable as before, capable of continuous reuse in the educational process. If we keep in mind that it is a catalyst, not an ingredient, then its cost and its effectiveness can be more realistically evaluated.

It is vital, however, that the right catalyst be used. Otherwise, there is no significant difference between using it and not using it. This is important to remember because so many of the hardware panaceas advocated by industry and educators are justified by the phrase that "when compared with control groups those students who were used in the experimental group showed no significant difference in accomplish-

ments." Now, when the proper catalyst is found as in chemistry it will bring about such a change in comprehension that the results are not only measurably different but unquestionably superior to the methods used with the control group.

Hardware can be thought of as one of some five parts comprising educational technology. The hardware is the machine, the electronics, the mechanics, the lighted projector without film. It may produce some light but the light alone does not illuminate any intelligence. To be useful, the projector needs the film. The hardware of educational technology must have the program, the software, whether it be film, tape, or text. To have a program, you need the content of education, and that content must be presented in accordance with the principles of learning and behavior. It also is necessary that the selected program relate to the student's environment, together with the appropriate procedures for that specific environment. If all these components of educational technology are not considered, the effectiveness of the learning-teaching process will be severely limited.

Now in order to consider all these parts we must bring together a variety of people and see that all work together effectively, each in his own realm. For example—hardware research is the realm of the engineer. Program research is the realm of the media producer, scholar learning research is the realm of the psychologist and environmental and procedure research is the realm of the educator and education administrator.

For these four categories of people to work together requires communication, but herein lies the real problem. Each speaks a different language. Effective results require that means be provided so the ideas of the engineer are comprehensible to the media producer and so on. Much of our trouble and difficulty with technology today can be traced to a lack, or intentional or unintentional misinterpretation, of information from members of this team.

Technology must be designed to facilitate solutions to the problems of education, which are serious today. Technology can remedy poor educational facilities and permit all to experience the best. It can support inadequately trained teachers by bringing the sound and substance of outstanding master teachers to all. It must work in the environment of the real world.

As an example, bringing adequate education to Samoa could have been attempted by sending to them fully qualified teachers from the United States, building U.S. styled schools at tremendous expense and, thereby, installing an oasis of United States culture in the islands. This might have been a wondrous, if not mystic, experience to the Samoans but it certainly would not have related to their environment. Instead, in this case, hardware, television to be specific, was brought right to the native schools. However, instead of using state-side educational programs and practices, a small group of master teachers produced material which related to the Samoan life; hence, the program was effective and easily understood. Instead of replacing poorly qualified native teachers with foreigners, the master teachers taught native instructors by means of television, thereby, improving simultaneously the quality and quantity of education and teaching.

There is possibly a parallel between this Samoan experience and our ghettos. Can we expect the children from a ghetto environment to learn from our middle class white teachers? They do not speak the same language. In relevant and environmental programing, and the use of Samoan TV inspired methods, may lie some of the answers to the problems in the ghetto schools.

Research is needed in the environmental aspect of education. As matters presently stand, learning activities and environmental and societal activities such as athletics, dating, hobbies and the like are often in such confusion and conflict that students cannot cope with them. The typical educational activities of the student are really basically five. They are: lecture and/or demonstration given by the professor and attended by the student, classroom discussions supervised by the teacher or graduate student, study where the student reviews his lecture with his lecture notes and reads and reviews any outside reading and other assignments, testing where the student demonstrates to his teacher what he has learned, and then feed back to both the student and the teacher of the results of this testing.

Now in the conventional educational process, considerable time elapses separating these educational activities during which other courses, activities, and environmental events occur. Hence, much more than the student's memory must be relied upon if he is to coordinate these activities in a meaningful and lasting learning experience. Research in the educational process resulting in such things as programed learning, can shorten to insignificance the time lapses by breaking down learning into modules in which all four activities take place in each sitting. Such total environmental research must include inter-relationships between courses and other activities as well as the retained learning aspects.

This is another area for education and industry research cooperation. The underlying principle of technology for education is that the instructor's or teacher's role must become that of a manager of the learning process. That is, he may be thought of as an engineer of the teaching, learning transaction system and the assigner, adaptor, and developer of material resources. The student becomes an active participant in the learning process, proceeding at his own pace.

It is more important that the learning concept present real world situations. Therefore, simulation and modeling are key functional components. Young students today are faced with many things different from what their counterparts dealt with yesterday. They are more aware of technological advances and progress and more familiar with the wide range of disciplines. They are often called upon to make a thorough analysis of all facets of a problem, to formulate a solution and alternate solutions, and to render value judgements. It is this spirit of inquiry and this attempt to derive and integrate elements on which to base an action or a decision relevant to practical problems in the real world that lead us to recommend adoption of the principles of systems analysis in any new approach to education.

This philosophy will no doubt inspire alterations in subject matter content as well as in instructional procedures and evaluation. The results of such system analysis may show that traditional education approaches have given lip service to, but never adequately dealt with, individual learning differences. A major premise of the educational technology is that it leads to individualized instruction whereby

the student proceeds at his own pace with material and systems adapted to his own needs and ability. It should be recognized that this capability is not a function of the hardware alone but includes the entire educational-psychological system in which objectives are specified and appropriate learning principles adopted. The hardware serves only to facilitate the materials and procedures. With individualized mediated instruction the student proceeds at his own optimum rate and learning is measured in terms of performance rather than time. With this individualized approach in educational technology, and not otherwise, we can deal with these processes and functions involved in the teaching-learning transaction.

The discrepancy between formidable advances made in scientific technology and used by government and industry and the less than adequate improvements in instructional technology over the past several years made by education is well known and talked about. In this regard it is important to note that the inherent capabilities of the new hardware and the flexibility of the corresponding content or software may enable the teacher to make similar giant steps. First, by giving the teacher the training and the tools for developing his own course materials, we enable him to design and mold his course according to today's student capabilities, research findings and requirements. Second, the audio-visual media, data banks and in some cases, even computerized instruction lend themselves to demonstration and modeling. This enables the teacher to introduce elements of the variable real time world into his curriculum.

With these thoughts in mind we can now turn to some hardware systems in educational technology, review the forms they take in our schools, and classify them by functions. We can start with those now in wide spread use and acceptance and progress to those which we see today as experimental models just appearing on our horizon.

First, there are teacher tools, a useful classification for all audio-visual equipment which the teacher uses in the classroom to help present a lesson. This category covers phonographs, tape players, projectors, and lab equipment. Their identifying characteristic is that the teacher is present in the classroom and the programing and operation of these teacher tools is under his complete control.

Second, there are teaching machines, a classification that has fallen into disrepute because some of the earlier devices, so classified, failed to perform any useful function and under varying names, often implied that a computer is included. A characteristic of teaching machines, however, is that of presenting programed instruction on an individualized basis to the student without requiring any appreciable supervision by the teacher or monitor. Another characteristic is that the program material, the software, is contained at the student's position. Additional operational characteristics of many teaching machines are the added ability for the student to control his pacing, provisions for his own response, and some means for profiling, scoring, and grading.

Third, we have student response systems. These provide each student in the class a capability to respond to the lecturer or teacher in lock step classes of any size, even when the class is divided into several different groups in different locations as, for example, when closed circuit television is used to teach several groups simultaneously. Such systems bring a measure of individualization into large classrooms and give the teacher the facility for checking the responsiveness, comprehension and attention of all students because all actively participate at the same time. The identifying characteristic is the means provided for all students to respond in a meaningful fashion to the teacher.

Fourth, we have audience expansion systems. These permit an expert teacher to teach and lecture two or more groups at the same time and at locations remote from each other. They include such familiar communication media as educational radio and television, closed circuit television, blackboard by wire, tele-lecture, etc. These systems may or may not provide for a bi-lateral transmission of information from members of the audience to the lecturer and may include transmission of recorded lectures.

Fifth, we have information retrieval systems. These provide for the access of textual, visual, and audible information by wire, from the central library, of such information. While, some of the stored material may be used for teaching, the function of this system is to provide desired information and materials on call as needed. This is analogous to a library service where the student asks for specific resources and they are delivered to him. Such systems are often known as DAIRS, which means "Dial Access Information Retrieval System."

Finally, we have remote access instructional resource systems, which take information retrieval systems one or more steps beyond and provide for individual teaching services of a wide variety of courses from any student location. These student locations, frequently called carrels, provide not only the audio and visual presentation hardware used in information retrieval systems but also hardware for the student to interact with the material presented. This is accomplished by means of such simple things as push buttons, pressure sensitive areas on display screens and even voice and constructed answers. The response of students is processed to alter the program and tailor it to his needs and his state of knowledge and comprehension. It isn't hard to believe that such a well designed system of the future may come close to providing an effective tete-a-tete between each student and an expert tutor.

In summary, here is a quote from a statement by the research and policy committee of the July 1968, Committee for Economic Development.

The quote relates to the goals of instruction which set a lofty position for us to think about. "It is not the task of the school to provide final solutions for all problems but rather to equip students to face life's problems intelligently and effectively. The end result of competent instruction should be desire and respect for knowledge and the possession of skills essential to getting and using knowledge. This means competence in verbal skills, especially the ability to read and write, to use language effectively, in the identification and classification of facts, and in the formation and communication of ideas. It is more important to generate intellectual curiosity and a passion for knowledge and to cultivate good habits of thought and inquiry than to concentrate on learning countless detailed facts which may soon be forgotten and abandoned."

I believe it's only by careful blending of the skills of the educator and the technologist that we can hope to achieve these lofty goals.■

DR. ANNA L. HYER
Executive Secretary
Department of Audio-Visual Instruction
National Education Association

Technology And Individual Building Hardware Systems

8

I might as well admit to you before you find it out for yourselves that I am misassigned and not competent enough to handle this topic. I am not an expert on building planning. I do not believe that we yet have technological hardware systems. Lastly, I am an administrator and as has often been said they tend to know more and more about less and less. The saving grace and my source of comfort is that the chairman and the reactor are both competent.

What I am going to do, therefore, is to describe briefly the changing educational scene as it relates to instructional technology and make some suggestions as to what this means for school plant design.

Educational Setting

Never in the history of the United States have we been looking at societal problems so intently and so openly, or struggled so hard to find new ways of coping with them. The schools as usual are coming in for major criticism. In a way, this is highly complimentary. The American people have a miraculous faith in their schools. This is one of the reasons the schools are often made the scapegoat of societal problems.

Here are some of the things educators are hearing.

1. You must educate **all** the children of all the people — plus more pre-school children and adults — to a quantitative and qualitative level previously thought impossible or impractical. Of course, the public wants this done with no increase in expenditures!

2. You must educate individuals so that they can live productive and well-adjusted lives in the densely populated urban areas and where many minority groups are concentrated.

3. You must prepare people to live in a more de-personalized technological society.

4. You must prepare students to cope with change and to be commited to life-long learning.

5. You must prepare students to be better citizens of the United States and the world.

6. You must educate for creative use of an amount of free time and leisure hitherto thought impossible to obtain.

These things and many more we educators are asked to do at a time of severe environmental unrest. Students are more militant. They are demanding a part in educational decision making, that schooling be more relevant to life and that new methods be used. The text-centered school and read and recite techniques can no longer compete with the new media of communication whereby students learn outside the school.

Teachers too are becoming militant. They want higher salaries, yes, but they also want more and better teaching materials and facilities. They want more

time for planning instructional programs and to work with individual students.

The public is more militant too about education. They are voting down local bond issues, demanding instant improvements, wanting a voice in running the schools and demanding more efficient and effective schooling.

Educators' Response

Educators have never been satisfied with the schools. They have always been trying new methods, updating content and making numerous other alterations. These, for the most part, have been gradual improvements over fairly long periods of time. This technique is no longer satisfactory for reasons I will touch upon later.

Educators know that presently they are failing with about 20 percent of the students. Many innovative practices, therefore, are being tried out. Some relate to new curriculum content and goals, e.g., emphasis on inquiry, creativity, problem solving and real life problems.

Some of the innovations relate to new organizational patterns which affect students and teachers, e.g., team teaching, non-graded school, independent study and differentiated staffing.

Other innovations related to the use of new instructional technology is to store, retrieve, or transmit, sometimes over long distances, audio, visual and textual messages and to increase interaction. This new technology usually plays an important role in implementing any new curricular or administrative change as we will see later.

Meaning for School Design

Out of experimentation of the last ten years, some principles seem to be emerging which have meaning for school building design. We don't have the bright and shining examples yet for me to show you here today, but we are beginning to know the nature of the activities, tools and facilities we want to house in the learning and teaching environment.

School Buildings

The conventional school building has a number of uneconomical features including long corridors, large lobbies, massive cafeterias, multi-purpose classrooms, and oversized independent study areas. In the same building, costs may be reduced by new scheduling arrangements that do not release all pupils regularly at the same times of the day, by using appropriate independent study areas as access routes, by spreading eating times and using self-service canteens, by designing new or remodeled facilities especially for large-group instruction, small-group discussion, and independent study and by utilizing community resources for independent study.

The important consideration is that we must save money on school buildings and grounds so that we have more funds for the more-important (so far as influencing quality of pupil learning) educational equipment and supplies. School buildings and grounds can be much smaller than at present as the total community becomes increasingly the educational setting. Moreover, the building should be an evolving thing, not a *fait accompli*; it should be a place where teachers and pupils work, not an overawing edifice.

Dr. Meierhenry of the University of Nebraska has visually diagramed his concept embodying the teaching area, the learning area and the social interchange area.

Let's look at some examples of the activities which go on in these types of areas and the types of tools appropriated for each. We must remember that in the illustrations, the facilities in use are only moderately adequate for the purposes for which they are presently being used.

The first example is from Hagerman, Idaho a town of 430 with an N.S. (Grades 7-12) with 180 students and 14 teachers. I will show 10" from the opening of the film "More Difficult Than Alike."

Audio-visual materials were being used by students for:

Information gathering filmstrips, motion pictures, television, telephone

Independent study dial access, 8mm silent motion picture, programed instruction

Discovery and inquiry educational games, computer-based instruction

Self-Analysis of performance language laboratories, videotape recorders

Next, I will show a segment of a film from Purdue University "The Auto-Tutorial System" showing a similar concept applied to college Botany teaching.

Let's look next at the tools which support the large group activities which are more teacher dominated. The tools used tend to aid or amplify the teacher.

To aid the live teachers' presentation we have overhead and multi-screen projection.

To add outside "mediated" resources we have television, telelecture and audio tape.

To monitor student response we have a student response system.

Less thought has been given to tools to support students and teachers in small group discussion and interaction activities. If a variety of materials is being used to present ideas and used by students in their independent study, isn't it logical that tools may also be needed to stimulate discussion to recall data and to serve as a testing situation? These spaces should, therefore, accommodate the use of overhead projectors, small filmstrip and 8mm projectors, display of pictures and objects, and use of felt board, etc.

The most overlooked area in school building planning is the space and facilities to support these media services — sometimes called an audiovisual center, instructional materials center or learning resources center. The big single room or complex which could store all the teaching materials and seat one-third of the student population is out. Decentralization is the key. This may mean decentralization of the materials storage. But because it is now often easier to move imformation than to move students and/or materials, it may mean electronic delivery to remote and scattered locations of information centrally stored. Examples are use of the dial access system, CCTV and computer storage with retrieval at remote consoles.

These media support functions must be housed in appropriate locations. The various types of locations are:

1. Storage of a wide variety of learning resources for use by students and teachers.

2. Equipment and related facilities appropriate for and easily used in individual, small group and large group settings.

3. Space to accommodate preparation of a wide range of teaching materials, e.g., mimeographed material, audio tapes, transparencies, charts and other graphics, slides, TV lessons, etc. This includes space for storage of raw materials, operation of production

equipment and space for conferences of teachers and media specialists as they plan and design instructional messages.

4. Space to accommodate minor equipment repair and servicing.

"School Media Standards" will be published jointly by the American Association of School Librarians and the Department of Audiovisual Instruction early in 1969. This publication will give in more detail the philosophy of the instructional materials center and the quantities of staff, material, equipment and space needed for quality education in an innovative school in 1969.

Lloyd Trump in a paper entitled "Needed Changes for Further Inprovement of Secondary Education in the United States" suggests the types of spaces needed and suggests the student capacity required in each for a school of 1,260 students.

1. Large-group instruction — 2 spaces for 300 students each; will be used about 60 percent of the time.

2. Small-group discussion — 20 spaces for 15 students each; will be used about 75 percent of the time.

3. Independent study

Social Room-Canteen — capacity 200 students

Library — capacity 100 students

Conference Rooms — capacity 100 students

Close Supervison Area — capacity 50 students

Learning Laboratories or Resource Center, Perhaps 25 — capacity 800 students will be used about 67 percent of the time.

Eight spaces, each about 1,200 sq. feet (one for each of the areas of knowledge) where pupils can read, write, think, listen, view, and converse quietly plus an area for each major subject area with the "tools of the trade."

Difficulties

In closing, I wish to acknowledge that there are many difficulties to planning, building and using the kind of school building I have been talking about.

One problem is the rapid change in technology itself. Some take a "let's wait and see" attitude. Will dial access replace the language laboratory? What format of 8mm will win out? What will be the role of the computer, etc.? But we can't stop and wait. The best we can do is to build in flexibility and to allow for early obsolescence. We seem to need more space per student and more adequate and better spaced electrical supplies.

Another problem is that faculty readiness for innovative programs does not always occur simultaneously with the planning for new buildings. Even more serious is the failure to understand that technology to succeed requires a systems approach. All parts of the program must move forward together in a coordinated way.

What is this technology that we expect to alter school building design? I like Charles Hoban's definition:

Technology is not just machines and men. It is a complex, integrated organization of men and machines, of ideas, of procedures, and of management. ■

DR. PHILIP LEWIS
President
Instructional Dynamics, Inc.

Technology And District-Wide Hardware Systems

I look on the use of media facilities, just as we view appliances in our homes, as utilities. I don't believe any of us ever think twice about turning on the water faucet and expecting water to come out, or turning on the gas stove and expecting some gas to issue forth or dialing the telephone and getting a number. We go through these kinds of things that are very customary at home. Yet, as soon as we begin to say that we should use the same approach in the school where it brings these services on tap so that they are convenient for the teacher or learner, we begin to react just a little bit differently. If we begin to look on the media facilities of the present and of the near future as conveniences that will take away all of the arduous kinds of preparation that we've had to do thus far in order to use media of any kind, then perhaps we have a very reasonable and logical basis for looking at things.

It was mentioned that programed learning was having somewhat of a rebirth. At this time, we're benefiting from what happened in this field almost a decade ago in not just going off in all directions with a simple format which cannot meet all of the instructional needs. Today, we really are benefiting from the investigations that have gone into theories of teaching and learning. We see that there are different kinds of materials that we can use for instruction.

My assigned topic is "District Wide Systems" but I'd like to first take a minute or two to make the point that in district wide systems—which will soon spread out into state-wide, regional, national, and international systems—each individual school and building must be equipped in a flexible manner that will accommodate hooking up to such networks. As we talk about individual school buildings, I think we can point to some several dozen installations over the country that have actually gone in this general direction. These institutions have put in some kinds of total communications or total instructional facilities, but they don't have all of the services that we know can be built into the system.

An architect generally sub-contracts different kinds of sub-systems, for example the clock-bell system, CCTU distribution, intercom, etc., but rarely are these facilities integrated. In this room, we have fluorescent lights which can be dimmed and this is something that maybe you want to get into and maybe you don't. But, in some cases, if you don't coordinate the planning of lights for the use of television, then you really have a problem. Some light installations have ballasts that produce a very pronounced 60 cycle hum and if you have this present in a room where you intend to bring a microphone and a television camera, you are going to pick up a lot of this hum and not have very good audio tracks on the video tape recordings. So, lighting should not be a separate or isolated contract in the planning.

As another example, many classrooms have unit ventilators and a lot of these are high velocity devices. Here again when you get the air rush, you also produce a lot of noise for pickup by microphones. If you design any kind of studio for production, you would have to have low velocity systems which, again, would not adversely affect the kind of things that you are going to do.

I know of one studio set up in one of our neighboring states where it was necessary to cool down the whole studio and then turn off the conditioner so that you could produce a program and record it without noise. You then turned it on again to cool things down before you were ready for the next production.

Some of the individual systems that were installed included distribution facilities for television programs that are received off the air. Nobody, in the beginning, thought of combining origination television systems that would tie into the off-the-air distribution systems. As we review study carrels and individual use of video, these areas also should be part of the total system.

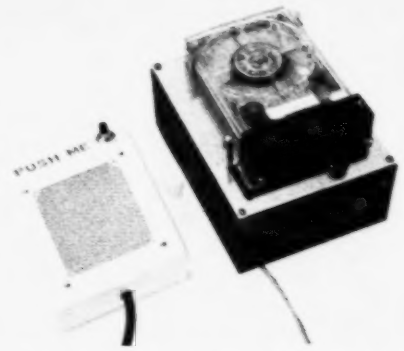
Many schools are putting in a single cable distribution system with the idea that they can insert in-school programing on channels not used by television stations in the vicinity. But, as soon as you get into instructional television and try to individualize it or try to provide enough programing so that it becomes significant, you find that the single cable is really not the answer. So in working with schools, one of the thoughts becoming quite prevelant today is that it is not possible when you build a school to really envision all of the applications of communications and media.

Therefore, the school should not be designed for all of the facilities immediately but arrangements made instead to be able to accommodate the progressive addition of such facilities as needs are identified and funds become available for terminal equipment. In many instances where schools have hung ceilings in the halls, you can put in a dual tray system that is capable of carrying both the AC conductors and the audio and coaxial cable materials. Some institutions are putting in a large control box in the wall, in every classroom, instructional space or seminar room. Some conduit stubs go up from the box to the overhead and terminate just beyond the drop ceiling. There is nothing in them initially.

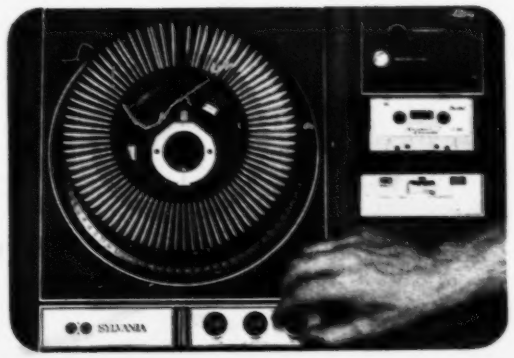
You may also have some conduit stubs leading from the bottom of the control box for connection to power sources. With this basic facility you have complete flexibility and can run cables in from the hall to the overhead down to the control box and make any immediate or future connections without tearing the building apart or without running surface-mounted conduit.

The first major idea then, is that you can't plan for everything now, but you can plan now for the addition of practically everything later. I think getting into district-wide systems should cause us to consider what some of the hardware capabilities are. These were somewhat summarized this morning by Mr. Shetler. They break down basically into two kinds of services. One is the service of supply where some materials are processed and duplicated centrally and then delivered to all of the schools or all of the agencies in the district. The second approach is to electronically distribute and interchange information via either telephone lines or coaxial cable and microwave links between the schools in a district.

I brought this small tape cassette along because it represents an important contemporary development in audio recording. There's a lot of confusion in defining the difference between a cassette and a cartridge. The cassette is a reel-to-reel type arrangement contained in a housing, such as the Norelco model which is widely used. The cartridge is basically a single tape loop. It is repetitive and self-rewinding. Both designs have advantages and disadvantages. The self-rewinding feature of the cartridge means that when you are finished listening to a recording, it's ready to go again. On the cassette, you do have to rewind but you get much



more flexibility in using the techniques of language laboratory instruction where for example you go back to review segments of the recording at any time. The cartridge is used in most automobile monaural and stereo systems as well as in home consumer products. During the next two or three years, there will be a very widespread use of both the cassette and the cartridge.



Sylvania has just put out the "home entertainment center." It contains a television receiver, slide projector, flying spot scanner and cassette audio unit that enables you to project your slides (with audio) on TV rather than on a projection screen.

Some of the other equipment combinations available include portable cassette playback recorder units accompanied by AM-FM tuners. This means that anyone can tune in a broadcast program and record it on a cassette in the little tiny unit that weighs no more than about a pound and a half or two pounds.

Norelco just put out an even smaller cartridge which is 5/6" x 1-1/4" x 2-1/4". It has capacity to record or play back 20 minutes of playing time. The total recorder with battery weighs 12 ounces.

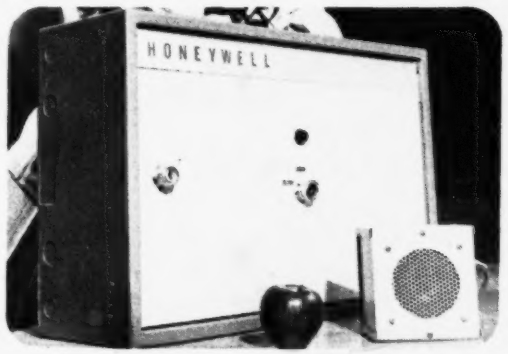
Other companies are putting out tape recorder/playback units which are about the size of a king-size cigarette package complete with cartridge and power source. As you see, this whole recording area is going to affect what we do with educational practices in many different ways.

As this development continues, perhaps instead of a card in the library catalogue which will show where a tape recording might be found, it might actually be the recording itself which you can pull out just as you may very shortly be able to take out a sheet of microfiche film instead of taking a book off the shelf. We'll come to that point in just a moment.

The use of audio tapes can go in many different directions. For example, for many years, particularly starting with World War II, we used the tachistoscope for aircraft recognition training. Some of you may remember the WEFT system. Then we began to use this approach in teaching reading to assist learners in developing perception. The reading accelerator came next and helped in decreasing the number of fixations per lines of reading material.

Recent experimentation indicated that we are actually able to hear at a much more rapid rate than we are able to speak. Now if this is true, and the experiments have more or less supported this, then we can do the same kinds of things, in effect, in an audio way that we do now for reading acceler-

ation. And so this Eltro device is a "speech compressor" if you want to use it this way.



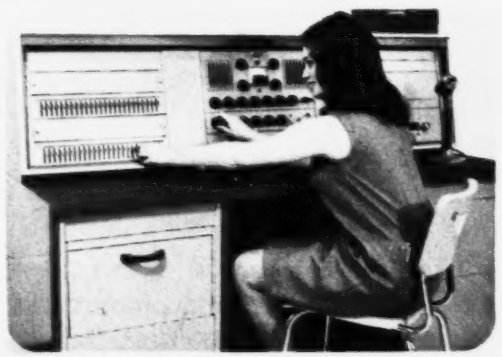
This means that instead of listening to me as I talk at my normal rate you would begin to listen to me as I talk at a much increased rate. This machine can take a tape recording made at normal speech rate, compress it to 20, 30, 40, or even at a greater rate than the higher rate tapes can be employed. The process will not change the pitch of the recorded speech. Just as a student may take a book and skim it for review, it is now possible to take a tape of a lecture and listen to it at a more rapid rate to conserve time.

This technology, used with blind learners, could actually double the amount of information that would be available to them in a given time period as compared to the rate used with "talking books." Compressed speech techniques are going to improve some of the audio approaches that we are now using. There are some other things you can do with this device. You can go the other way and expand the rate of delivery without changing pitch. If the output is fed into an oscilloscope, a speech therapist could make a visual diagnosis of certain kinds of abnormalities.

The third thing that can be done with the Eltro device relates to music. If you have a musical arrangement that has been composed for, say, a tenor, it is a simple thing to adjust it so it will change pitch and range and use it for a singer in the bass range. We should look on all of these tape facilities as having an almost infinite number of applications for instruction and learning.

There are some current programs of subscription tapes on the market. With this medium, you don't have to wait undue periods to learn what is really new in a given area or field. Of course, tape duplicating and distribution, will certainly be one of the popular centralized functions on a district-wide scale for obvious reasons.

This is a carousel-type programed machine. These units are used in radio station operation where almost everything is pre-recorded and put in the carousel. Instead of projecting slides, it inserts a tape cartridge and plays on electronic cue. This arrangement has interesting possibilities for random access programing.



Here, of course, is an inter-communications console. Most schools have such equipment and use it routinely to page a youngster in class, or to give Miss Jones a message, etc. But, the important uses of the intercommunications system are yet to be exploited.

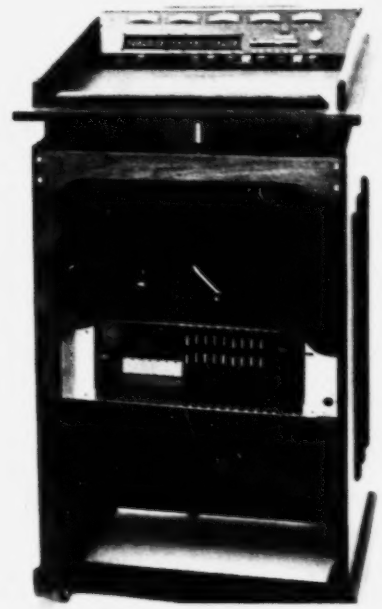
For example, in putting in an intercom system, it is important to specify that two or three conductor pairs are connected to each classroom or learning space. With this provision it is possible to do a wide variety of things. For example, you can have programing channels which can eminate from a communications or program center. In this way, teachers and student can have a variety of audio choices in addition to your regular communications channel. You also can have over-ride provision for emergency announcements, and of course this is a must because of air-raid and fire drills.

I'm sure you are all familiar with telelecture. Conventionally, a local amplifier is put in a classroom and connected to a telephone circuit. The students can hear from senators in Washington or scientist in Huntsville or a research person in Palo Alto. After listening to such presentations, students can participate in two-way audio exchange.

I mentioned that it is necessary to put a telephone line into the classroom. Now if you have the right circuitry in your intercom, it can make every classroom completely ready for telelecture. All you have to do is bring in the telephone line to the intercom master console and patch it in for use with whichever room or group of rooms you wish.

Now there is a little hang up here. As you know, the local state subsidiaries of AT & T have certain regulations as to how you can patch into their facilities. We have been able to get permission to do this in our own state and I'm sure you can get this kind of permission in other locations. There is some precedent for this approach. For example, Bell Telephone will provide coaxial cable channels to connect school buildings together for closed circuit television. You can use your own internal distribution system, however. Why not the same treatment with the intercom?

Minneapolis Honeywell has devised a sub-console unit which can tie into a regular intercommunications console so that after hours, or in some areas during school time, the intercom system also becomes a security system. There are many ways of doing this. You can use noise level as an indicator. If the ambient noise goes above a certain level in a particular area, it immediately triggers a warning light or rings a chime on the monitor board.



I referred earlier to the idea of having a control panel in the teacher's

classroom. You've seen the elaborate lecterns they have in lecture halls and auditoriums where the presenter can actually dim the lights, control multi-media projection, check the level of the public address system, etc. Why not provide similar but appropriate controls in the teacher's classroom?

For example, it is very difficult for most schools to have secretarial assistance available to teachers. Therefore, part of the intercom set-up can be the inclusion, or the addition later on, of control dictation recording equipment. This means, if you had a control panel in the classroom, the teacher could view the panel and, if the red pilot light isn't indicating that the system is taking dictation somewhere else, she can plug in the microphone and dictate the letter home to Johnny's mother or whatever she wants to do. The system records automatically on a receiving mechanism. When the belt or disc is full, it switches over to the next empty unit. The pool stenographer can do all the typing and transcription and provide a total service.

Touch-tone random access will become increasingly popular because this technology will give much greater flexibility in the future than will dial access. Dial access refers to a type of cross-bar switching or some other type of mechanical switching. Touch-tone incorporates solid state switching which is the coming thing. It will more easily adapt to future kinds of technology. One of the most important questions you must ask before installing a remote access system is, "can it be expanded and adapted to future uses without prohibitive investment?"

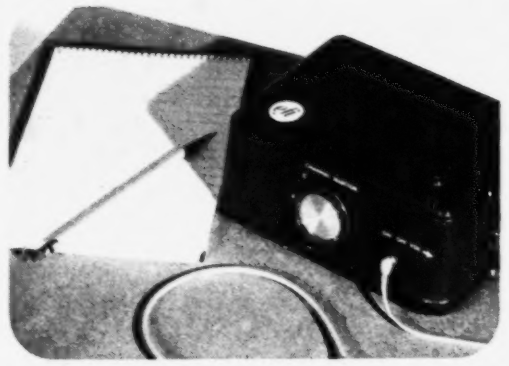
There is an installation in the Oak Park-River Forest High School in Illinois where they have embarked on a most exciting project. This is really a pilot project in the random access field. They are still testing the equipment and producing programing. Push buttons located in carrels are employed to select programs. There are six high-speed tape drives in the program center, each with 32 playback tracks. These units operate at very high speed. If a student punches up a program, one of the storage program banks will begin to play back at a rate that will transfer the information recording for re-record on an interface tape that's connected to the student's carrel in about 30 to 40 seconds. So the most a student ever has to wait for a program is 30 to 40 seconds, if he gets a busy signal.

This approach is an attempt to overcome the current practice of using four tracks simultaneously on quarter-inch tape in order to cut down on expense. The Oak Park-River Forest system is expensive at present but points the way via the study carrel route and its extention uses.

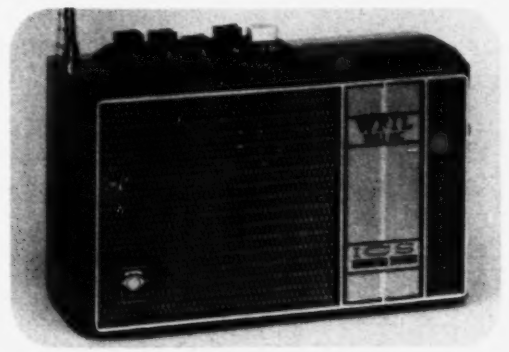
There are many considerations that you have to review before you go into a system of this kind. One of the other questions that has been raised is, for example, why do you need a local switching matrix if you also have a very complex and competent computer available? It is quite possible that in the near future switching functions for a school can be achieved with on-line time sharing.

It's a simple procedure to plug in a television camera to a classroom network connection and remotely record at the communications center for audio and video, or video alone. There is also the possibility of multiple group instruction either "live" or pre-recorded with the same system.

The material that follows includes some of the "wireless" facilities available for school use.



This is an EFI four-channel wireless broadcaster but it broadcasts only within limitations of a conductive loop which is installed around the instructional area. The tiny receiver is solid-state and the small battery it contains will last about a semester or a year, depending upon use. Here you see the receiver unit in use. There is the selection of four channels corresponding to the push buttons on the device.



This is an unusual instructional system that was originally promoted by International Correspondence School. They were trying to overcome one of the problems that all of us in education have been facing, i.e., how to get active participation on the part of learners when you have a broadcast course of any kind. What they have here is an FM receiver with four push buttons on the top. This FM receiver could be in this room or any place within range of the participating station. The main broadcast channel is the instructor track and side bands are used for the branching tracks. Programing is pre-recorded on tape, the instructor presents lesson material and may come to a point where he will say, "do you agree or do you not agree with this premise? If you agree push button A. If you disagree, push button B."

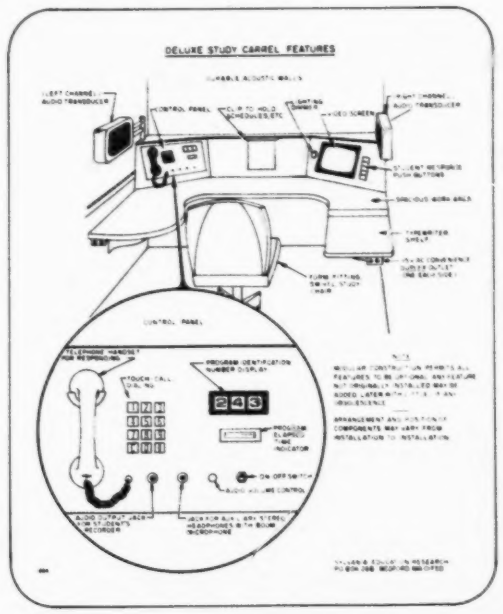
Now if you push button B and it's the wrong response, you'll hear the instructor's voice say, "well, you said B was correct. Let's see why your selection is not the right one." The continuing discourse will take the student through the requisite remediation and he will be advised to push A. The second selection will further develop the concept and finally route the learner back to the instructor channel. By this time everybody is on the "main line" and the program progresses. With this system, you can have branch programing and learner participation.

There is also the possibility to adapt this method to television. A multiple-choice question appears on the screen. It is followed by the alternate answers and the screen is divided into four quadrants. An alternate answer appears in each of the quadrants. The learner then pushes a button on the TV set to indicate his choice. At this point, the three other quadrants (alternate answers) blank out. If the answer is right, it stays on the screen. If it is not the right answer, it disappears and the right answer comes on for reinforcement which goes along with programed learning techniques.

Let's consider installations for carrel learning. This is one of the most misunderstood areas. There are many definitions—all of which accurately apply in specific situations. Some carrels resemble open telephone booth stations. Others are partitioned areas of

a large table. Some are quite elaborately designed and fitted with multi-media facilities. "Dry" carrels are study units to which materials and equipment can be brought as needed. "Wet" carrels are electronically connected to a programing source or center. Despite these two general categories, carrels can be adapted to a wide variety of general or highly specialized purposes.

This is a Raytheon "wet" carrel. You have audio, video and dial access facilities. There is a set of responder buttons for student feedback purposes and for programmed learning participation. The responses activate a paper tape perforator which is later processed by computer to produce individual readouts. The teacher is thus provided with progress records and can validly prescribe follow-up study.



One innovative approach incorporated in the DAIRS carrel is the elimination of the use of headphones. Instead, two low-level loudspeakers are employed. You can have stereo or monaural audio reproduction and the speaker chambers are shaped acoustically so that sound will not "spill over" into adjacent booths. Although this is a working prototype, eventually the booth walls could have parabolic forms pressed into them that would result in a more pleasing appearance. Such developments hold promise for production of study carrels that have more of the human factor in mind. I think this is most important.

In random access systems, instead of putting tape players or tape decks in a carrel, you can locate such equipment remotely. Students will have sets of four or five buttons in the carrels for record, fast rewind, playback, fast forward, and other kinds of functions. There is an obvious advantage in not having the equipment handled directly by the learners.

Now, let's consider the whole range of responders. This is the Edex System that Raytheon has and this is their simple indicator and programer device.

Such units are installed in classrooms and can be set up in different rooms as required. There are auditoriums that have some five hundred to one thousand of these in chair arms for response. For example, if you had responders installed in the chair arms where you are sitting, I could suggest, "as we continue with this presentation, if there is anything that you would like a little more explanation on, push Button A and if there is anything that you would like to take issue with, push Button B, or if you have a question, push Button C. The response meters would be located up front so that I would know of your responses without delay and could shape my presentation to your satisfaction.

This is one of the more elaborate lecterns that I mentioned to you earlier. It has all sorts of things incorporated, including the data feed-back from the responder units. Here you see a learning laboratory tied in with a responder system so the sub-systems are integrated to result in a more complex but highly utilitarian learning facility.

This typing trainer uses a small computer to teach touch typing. If you've never typed before all you have to do is sit down at the carrel and the rest is practically automatic. You can really learn to type without a teacher being present because you go through several phases and merely react to the light cues and other programed promptings. It is so programed that if you are having problems, the program slows down in its presentation. If the computer "sees" that you are doing very well, it speeds up the presentation with new challenges.

The Electrowriter is an XY ordinate device which will work over telephone lines. It is like the old telautograph used in the department stores. Many of the modern electronic versions are installed

in stores at airline reservation desks, etc. As you write on the device, you can also speak into the microphone. Two sets of telephone lines are utilized to transmit the visual components and the audio components for adding another dimension to the telelecture concept.

What has been covered is a representative cross-section of the available technology. The important thing is to choose wisely for specific needs and to think in terms of systems rather than isolated items. ■

DR. ROBERT DE KIEFFER
Director of Audio-Visuals
University of Colorado

Technology And Higher Educational Facility Hardware Systems

16

Today I want to discuss with you the implications of new educational media. However, we must frame this discussion around the problems of education in an attempt to determine why we should consider the use of media, what they are, and how their effective and extensive use will affect the educational institutions of the future.

A. Education in crisis
   1. Underlying causes
      a. Population explosion
      b. Increase in the number of students going to school at all levels
      c. Lack of teachers
      d. Lack of facilities
   2. Educational problems
      a. Lack of public support
         (1) Attack on school curriculum, methods and activities
         (2) Financial support
         (3) Segregation vs. integration
      b. Lack of awareness by educators
         (1) Concern for maintaining the status quo
         (2) Poor vision as to what educators must become
         (3) Disregard for recognizing the need for curriculum reorganization by systems analysis
         (4) Conflicting views regarding individual students (the gifted, normal and exceptional student)
         (5) Need for revamping teacher education

Educational objectives
   1. Education in the United States has many objectives; however, most of them are based upon three assumptions which are as follows:
      a. Efficiency (that our children and grandchildren should have the right to a better education than we had)
      b. Universality (that all of the children of all of the people have the right to an education)
      c. Quality (that teaching is a creative art but that the technological revolution in communication must and will assist teachers in utilizing their creativity to the optimum)

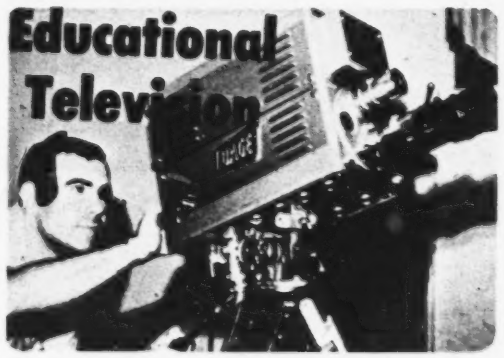
Educational Media

A. Definition: "A term used to describe a variety of materials and devices designed to provide educators with component parts of a system to enable them to communicate better with students."
B. What are they?

1. AV MATERIALS AND EQUIPMENT
2. EDUCATIONAL TELEVISION
3. SELF-INSTRUCTIONAL DEVICES
4. ELECTRONIC LEARNING LABORATORIES

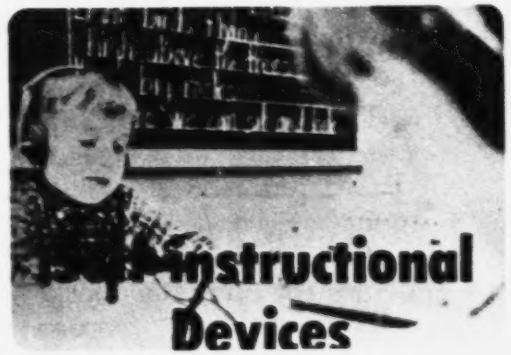
1. AV materials and equipment
2. Educational TV
3. Self-instructional devices
4. Electronic learning labs

C. Audiovisual materials
   1. Definition: "Audiovisual material are any materials used in a learning or teaching situation which facilitate the understanding of the written or spoken word."
   2. Characteristics of AV materials
      a. Three main categories: Non-projected, Projected, Audio
      b. Non-projected materials
         (1) Bulletin boards and chalkboards
         (2) Maps and globes
         (3) Models
         (4) Live objects and specimens
         (5) Study trips, pageants, plays (etc.)
      c. Projected materials
         (1) Slides and filmstrips
         (2) Opaque projection
         (3) Overhead projection
         (4) Motion pictures—both 8mm and 16mm
      d. Audio materials
         (1) Records and discs
         (2) Radio and tape recorders
   3. Strengths envisioned for AV materials
      a. Serve as means of presenting data
      b. Make meanings clear, bring the learner closer to reality
      c. Make learning more permanent
      d. Have affect upon attitudes and behavioral responses
      e. Gain and hold attention



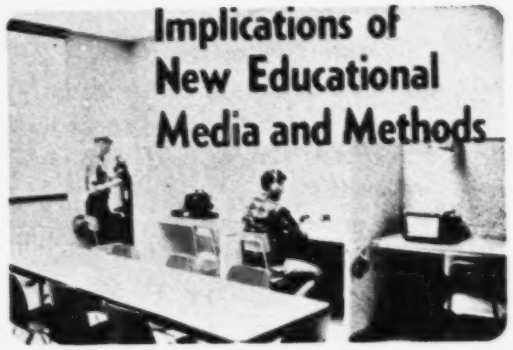
D. Educational television
   1. Definition: "Educational television is a method of transmitting light, shadow, and color accompanied by sound, for educational purposes."
   2. Characteristics of educational television
      a. Classroom enlarger
         (1) Definition: "A method of enlarging any image, including microscope slides, with a small industrial vidicon camera and sending signals to one or more monitors."
      b. Closed-circuit television, also known as instructional television
         (1) Definition: "A system of sending televised pictures, accompanied by sound, from a point of origin to various points by wire or microwave rather than by transmitting the signal through the air." It is now possible to transmit signals through the air by 25,000 mega-hertz but to restrict their reception.
         By using coaxial cable or microwave, several programs can be provided simultaneously, thus allowing each viewing area a choice of program.
      c. Open-circuit television
         (1) Definition: "The sending of television pictures and sound from a point of origin to any receiver within the viewing area via air waves."
            (a) Sustaining time on commercial stations
            (b) Non-commercial educational stations
   3. Strengths envisioned for TV
      a. Provides courses and materials not otherwise available (mathematics, language, music)
      b. Aids the gifted and exceptional children, either by providing special instruction itself or by providing standard instruction for the average student, thereby freeing the regular teacher to spend additional time with the gifted and exceptional student.
      c. Makes use of outstanding teacher and his team
      d. Provides quality instruction to large groups of students simultaneously. Further with the use of video tape, it can provide identical instruction to smaller groups on a scheduled basis.
      e. Allows "front row" observation of experiments and demonstrations.

E. Self-instructional devices (also known as programed learning and teaching machines)
   1. Definition: "A wide range of material and devices which aid in the self direction of the learner."
   2. Definition: "Programed learning is a strategy for presenting information to an individual step by step."



3. Definition: "Teaching machines are **devices** which aid in the self direction of the learner."
4. Characteristics of programed learning and teaching machines.
   a. Programed texts
      (1) Introduction to modern mathematics
   b. Scrambled books
      (1) Klystron principles
   c. Simple write-in machines
      (1) Graflex koncept-o-graph
   d. Multiple-choice machines
      (1) Punch board
      (2) Self-scoring machine
      (3) Auto tutor
   e. Subject-matter trainer
      (1) Electric board device
   f. Automatic tutors and raters and C.A.I.
      (1) Air force computerized training device
      (2) Computer bank
      (3) Student at C.A.I.
5. Strengths envisioned for programed instruction and teaching machines
   a. **Economical method of instruction** which employs proven learning principles
   b. Can be **adapted to a wide variety of courses** at all levels of instruction
   c. **Simultaneously provides for the fast and the slow learner**
   d. **Relieves the teacher shortage** in seldom taught fields, i.e., uncommon foreign languages, electronics, higher mathematics
   e. **Relieves** the **teacher of routine drill** and repetition

F. Electronic learning labs: closely related to self instruction
   1. Definition: "A resource center which is uniquely adapted to individual differences in rate, capacity and maturity."
      Emphasis is placed upon the student's self-direction and shared cooperation. It brings to the student a wide variety of resources with which to complement instruction.
   2. Characteristics of learning labs
      a. Individual study studios and practice rooms
      b. Small study and meeting rooms
      c. Telemated auditoria (rear screen or front screen projection)
      d. Student responses systems
      e. Telelecture
      (1) Rear projection and video tape recorder
      (2) Rear projection and large lecture room
   3. Strengths envisioned for electronic learning labs
      a. Provide areas for learning drill-type materials
      b. Provide for student access to a wide variety of materials
      c. Allow students to work at their own speed and to the limit of their capacity
      d. Allow flexibility for individual, small-group and large-group activities



Implications of new educational media and methods

A. Changing facilities
   1. More flexible construction to allow for
      a. Individual student space equipped to utilize a wide variety of electronic media including teaching machines, TV, storage and retrieval equipment to bring them any printed, pictorial and/or audio signals
      b. Small-group activity space in which a wide variety of audio and visual media can be used at a moment's notice by the teacher or students. The electronic classroom will be connected with the major national and international information, storage and retrieval center for rapid presentation for all types of information for analysis and study.
      Students desks will become satelite substations equipped with viewing screens, ear phones and computer terminals providing them with facilities to analyze, study and calculate the educational problem under discussion.
      c. Large teaching auditoria of 100, 200, 500 or 1,000 student capacity in which the teacher will have complete control of all projected and audio media to implement the lesson and equipped with a student response system to enable the teacher to evaluate the quality of his teaching and the amount of learning that is taking place.
      d. A variety of learning laboratories for audio-active and

audio-passive student positions for practice and drill in language, music appreciation, speech correction and diction, and others

e. A materials center for the production of instructional materials which are tailor-made for the unique requirements of teachers and students
f. Also this center will be the major complex for the storage and retrieval of information for the auditoria, the classrooms, the learning laboratories, and the individual study stations. But it will be considered only as a substation in the total knowledge bank which will be available.
g. The center will be capable of providing students data in various formats in cafeteria style banks.

B. Changing school day
   1. Student oriented rather than administration oriented
   2. A flexible student schedule will allow for large-group instruction, small-group discussion, independent study time, and the opportunity to study in depth his own area of interest

C. Changing teacher's role
   1. The teacher is still the heart and soul of the learning process. Schools of the future will provide an opportunity to make more effective use of his unique contributions. Both professionals and para-professionals will be available to assist him.
   2. Teachers will be freed from many of the non-instructional functions such as roll-taking, room monitoring, paper grading and other like functions. Non-professionals will be available to take over these non-teaching functions.
   3. Teachers will be an integral part of the teaching team and have more time to devote to helping individual students with their particular problems.
   4. Teachers will be expected to conduct more research to determine the effectiveness of their teaching methods and techniques and the supervision of the selection, production and utilization of teaching tools. Also to conduct systems analysis in curriculum revision.

D. New possibilities for technology
   1. Free the teachers from routine drill and repetition, thereby freeing them for more creativity.
   2. Free the curriculum from its stereotype.
   3. Raise the quality of education by providing more and better education.

E. John Ivey, president of Learning Resources Institute, Princeton, New Jersey, former executive vice president of New York University (SATURDAY REVIEW, February 13, 1960, **Teach, Transmit, Transmute**):
"The American education system has helped produce one of the most scientific and highly technological societies in the world; yet the premises which dominate our educational processes have had too little scientific testing. Nor have schools and colleges even scratched the surface in bringing into the educational process the technological revolution in communications which is shaking the very roots of modern society — instead of producing an increasingly superior product faster, we can expect it to take longer to attain perhaps a lower level of quality."

F. New dangers of technology
   1. Subject-dominated curriculum
   2. Machine control of the curriculum
   3. Curriculum control of the students
   4. Dependency on gadgets

G. Time for action
   1. We must start now to carry out more comprehensive research in human action.
   2. We must attack the problems of education with an open mind.
   3. We must start now to experiment with various types of new educational media.
   4. We must, in our curriculum revision, apply the strategy of instructional systems and go deeper into learning about teaching problems than the mere deletion or combination of existing courses.
   5. We must not allow automation and technology to dictate the curriculum as the textbooks have for the past 200 years.
   6. Teaching is a creative business. We must begin to use creativity in teaching and learning.

Conclusion

Ernest Melby: "To many, the points I am making will be depressing. The subject-matter researcher would like a world in which children and youth learned without help, freeing him for full-time research. The big taxpayer would like mass methods of education through television or films for large classes. Educational administrators and many teachers hope for curricular changes which make creative human relations unnecessary. But to all these we must reply that teaching is an art, and machines will not replace teachers any more than machines will paint pictures or compose symphonies. Machines may help but the degree to which they help will depend on the creativity of the teacher. The time will never come when creative living with students ceases to be the essence of education. On the contrary, the more we learn about education the more important the teacher becomes." ■

DR. CARROLL V. NEWSOM
Vice President of Education
Radio Corporation of America

Technology As It Affects Educational Planning

Undoubtedly it is true, as some persons have suggested, that there is really nothing new in what is presently described as a systems approach to educational planning. Nevertheless, it can hardly be denied, partly as a result of the present attention to a systems approach, that educators are now involved in the development of an analytical approach to the solution of their problems; it is especially true that they are giving greater emphasis to educational purposes and objectives. For too long, academic programs, even educational institutions, have had no motivational goals other than vague moralisms such as "to train for good citizenship," "to educate the whole man," "to provide a broad understanding," or "to push back the frontiers of knowledge."

It has now become clear to astute observers of the educational scene that no school or college can operate in a manner that is efficient and effective and will be satisfying to its sponsors and to its student clientele unless it determines its proper destiny within the framework of our society. Thus it becomes mandatory that a school or an institution of higher learning attempt, as rigorously as possible, to enunciate its purposes and objectives. Insofar as possible, especially in the case of the schools, objectives should be defined in such a way that their achievement is determinable. Ambiguous, vague and meaningless phrases can hardly be utilized as goals to provide a basis for the development of policy or the planning of program.

There is wide-spread acceptance of the principle on the part of American citizens, an acceptance that is consistent with national, economic, sociological, and political needs, that the school, often followed by college, should attempt to provide each boy and girl, each young man and woman, the educational foundation that is required, compatible with his interests and abilities, in order that he or she may undertake a useful and satisfying role in society. To undertake the accomplishment of such a broad objective, even before an attempt is made to develop a set of specific goals, demands, initially, study of the student population that is the responsibility of a particular school or college.

On the college level, for example, the use of college board scores and other criteria for admission to college that tend to reinforce each other in the selection of students with somewhat similar patterns of abilities has been common, especially in recent decades. Thus many of the so-called selective colleges and universities do have student groups composed of young men and women who are decidedly alike in certain key intellectual attributes, especially in regard to their verbal skills and their capabilities in handling symbolic discourses such as those of mathematics. This interesting commonness of patterns of mental characteristics, as found among students on certain campuses, is undoubtedly a factor in some present-day college phenomena, including the recent stu-

dent upheavals. For colleges and universities that attempt to serve the needs of such students, a library of books, soon to be modernized with computer control of many aspects of its operation, will and should remain at the heart of most instructional activity.

But students with the special intellectual attributes I have just described are, and always will be, in the minority. There are – and the number is increasing rapidly – many able students who desire post-secondary education and for whom such an education is desirable. The students, let me emphasize, are able, and society needs their cultivated talents, but their abilities, interests, and the nature of the forces which provide them motivation differ from those of students for whom most of our colleges and universities have traditionally had a concern.

In an important recent article by J. P. Guilford[1], Director of the Aptitude Research Project created in 1949 at the University of Southern California, he writes, in telling about the Project, "attention was concentrated on tests in the provisional categories of reasoning, creative thinking, planning, evaluation, and problem-solving. Nearly 20 years later, the number of separate intellectual abilities (that have been observed and studied) has increased to about 80, with at least 50 percent more predicted by a comprehensive, unified theory." And these abilities, I may add, are certainly not distributed uniformly in any population.

The institutions that are demonstrating leadership in attempting to serve the needs of students with unorthodox interests and abilities, as measured against traditional college norms for the selection of students, are the newly-created community colleges. They are learning how to make appropriate adaptations of curricular content and instructional methods. But I am happy to note that other colleges are beginning to sense the challenge and the opportunity of providing education to students who possess unusual competencies and interests; such colleges are beginning to give special consideration to those students who may have come from environments where little attention was given to the cultivation of abilities measured by the devices commonly employed when determining college admission. The instruction of such students, it has been my observation, must involve a heavier use of audio-visual materials than has been common in traditional institutions of higher learning. The best gateway to the mind for a large number of these students, especially when assisting them in connection with certain types of exposition, is to be found in the visual and the audio rather than in the printed word. Libraries in institutions serving the needs of such students must give proper emphasis to the availability of audio-visual materials. The rapid development of the tape cartridge for both audio and visual will facilitate the creation of the essential emphasis. In addition, classrooms, seminar rooms, and study cubicles must be equipped to provide easy access to audio-visual materials, most of which, in the near future, will be stored in central depositories; modern communication devices will be employed to transmit a desired audio-visual item to the locale where it is desired. The contrast between student populations in two types of post secondary institutions has been portrayed for the purpose of emphasizing the necessity for a proper recognition of differences that should prevail in institutional planning of instructional resources and facilities.

On the school level, remarkable differences in student populations as one moves from school to school are becoming apparent. For instance, in general, there are critical differences, that must be the concern of educators, between the student populations in rural schools and in urban schools. Too frequently an instructional program is developed without ascertaining in an adequate manner that the students possess the foundation which the program requires. Teachers can anticipate the availability of more and better testing programs to assist them in making the necessary determination. Ever greater attention must be given to the fact that students can be thoroughly baffled if they do not possess an adequate understanding of the background of a problem or concept in terms of their experience. A very ambitious school boy in an urban community broke down in tears when he was given the problem, "If 95 percent of the 600 eggs in an incubator hatched, how many baby chickens were there"? Through his tears he explained that he didn't understand what was meant by the hatching of eggs and he knew of no connection between eggs and baby chickens. A seventh-grade girl in a large city, who enjoyed the poem about "Mary and her Lamb" explained, when given a problem pertaining to Mary and the lamb, that she did not understand the problem; it developed that she believed Mary's lamb to be a "fuzzy jacket that Mary always wore"; she had never seen a lamb. With the pronounced population movement toward the large cities, many students do not possess the background to understand the setting for a considerable number of common expository presentations and problems, relics of a rural environment, that still appear in textbooks. The future will see much more studied and conscientious effort by all of those involved in the design of instructional materials, often through the use of audio-visual displays, to provide each student a necessary background of understanding so that his studies will be meaningful.

But irrespective of the nature of a particular student group, the teacher must face the problem of individual differences. As already implied, it is now recognized that there are gross differences in human capabilities. Instead of one kind of intelligence, there are many. Vast differences also exist among people in their interests, and great variation occurs with respect to the manner in which individuals may be motivated to perform some desirable task or tasks. Heredity is undoubtedly a factor when we are seeking the basis for the existence of individual mental differences among members of the human family. But the evidence is now very strong that the most significant factor in providing an explanation for such differences is associated with the substantial variation in environments in which the young are born and raised. So, when designing instructional program and strategy, the educator must understand that each person's intellect at any particular time in his personal history is a unique composite of abilities, interests, and the other factors with which psychology is concerned. The very fact of the great variety of human intellects available to society may be most fortuitous as society struggles to meet the great variety of its needs.

It seems clear to me, if our society is to serve its own requirements as well as those of its citizen-members, that educational planners must try to meet

the diversity of educational demands posed by students under their supervision by making such modifications of the instructional program, in both content and methods of instruction, as would appear to be desirable in the case of each student or particular collection of students. Unfortunately, in my judgement, most of the schools as well as the long-established colleges in the United States have become imitators; they all look alike. There are many reasons for this fact; most of you are quite aware of them. However, as already indicated, it is my strong conviction that each educational institution, on the basis of needs to be served, must determine its own distinctive destiny. We need many more institutions which have refused to be cast into a traditional mold and which have made a serious and successful attempt to provide particular services to students with particular interests and abilities. Such an accomplishment is the true mark of excellence.

Much needs to be done in the development of instructional strategy toward resolving some of the educational problems associated with the fact of student differences. However, attention to provisions for independent study and the creation of small discussion or work groups that make possible the interplay of active minds appear to be an essential element in the necessary considerations. One college which I have observed in recent years permits each professor to develop his own interpretation of a desirable manner for providing instructional supervision for a three-hour course, for example. A typical interpretation might provide for one hour per week of lecture with the remainder of the student's time spent in student-conducted seminars and in carrying out individual designed projects. Each student has his private cubicle in the institutional learning center and every cubicle has easy access to a central collection of audio-visual materials as well as books. The physical facilities of the institution have been carefully designed to accommodate the needs of the instructional program. Officers of the institution believe, based on the evidence, that the present instructional technique produces better results at lower cost than when the college followed traditional patterns. Similar attempts to build greater flexibility into the instructional program can be cited on the school level.

Proper attention to the multi-media approach to teaching becomes especially relevant when attempting to solve the problem of individual differences. When developing an exposition of a concept, the teacher can and should choose the medium or the combination of media that would seem to be most effective – when weighed against the needs of the subject matter as well as the mental characteristics of the student.

Now it is possible, through the use of recordings, to hear a poet read his own works, and these recordings may be brought into the classroom or study cubicle from a distant resource center within a few seconds after the teacher or student pushes a set of signal buttons. The new audio tape cartridges also become an invaluable asset in classroom teaching and for the use of students indulging in independent study. Now it is becoming possible to observe a film of wave action in water to supplement and illustrate mathematical demonstrations, and within a few years it will be common to show a film on a display surface in the room where it is desired by signalling the controlling computer in the resource center which may be many miles away. Tape cartridges containing both audio and visual records, to be inserted in modified television sets, will soon be available as library items and for assorted instructional purposes. Possibly the most significant development pertaining to the use of technology in education pertains to the usefulness of the modern computer. A vast number of students in our schools and colleges, along with research personnel in industry, are already using the computer to solve long and complex arithmetical problems and to simulate the data structure of experimental situations that previously were handled almost entirely through the creation of laboratory experiments. Learning how to program a computer has become virtually mandated as a field of instruction in both school and college. Computer-controlled "drill and practice" exercises are being employed in a variety of schools and colleges to supplement and extend the regular instructional program in certain subjects, and success has attended efforts to program a computer to carry on a Socratic dialogue with a student who is attempting to become proficient in a particular area of knowledge. Computerized language teaching programs have been remarkably successful. In fact, there is virtually no limit to the possibilities of programming a computer to interact with a learner in such a way that effective learning experiences are provided. In recent years, the contributions of technology to instruction in many schools and colleges, as illustrated by previous comments, have been notable; moreover, the availability of modern technology is already having an effect upon instructional philosophies and is stimulating new-type research endeavors pertaining to instruction and learning.

Language laboratories, introduced a few years ago, have revealed that significant educational values result from learning experiences provided to students in which modes of pronunciation and acceptable kinds of syntax are demonstrated by the recorded voices of linguistic experts. But the traditional language laboratory, it is interesting to note, is now being absorbed into a variety of modern types of learning laboratories or instructional environments. In these instructional environments, printed, audio, visual, and computer resources are being made available in an easily accessible way by synthesized hardware systems to assist a teacher or a collection of teachers in carrying out well-conceived instructional endeavors in a variety of subject areas. Such instructional environments, it may be emphasized, should be designed to accommodate specific instructional purposes and situations.

Courses in art are becoming meaningful because of the fact that easy access is being provided in the new instructional environments – in lecture halls, in classrooms, in individualized study cubicles, in seminar rooms, and in other instructional environments – to reproductions of art masterpieces, along with appropriate commentary. Because of easy accessibility to audio recordings, new emphasis is being given in both school and college to instruction in spoken English, drama, and in music. The social studies are rapidly becoming virtually new disciplines since selected audio-visual displays can be employed to create an appropriate initiation to the discussion of a particular subject, and other displays – usually shorter displays – can be introduced to illustrate and reinforce an understanding of particular concepts.

No longer does the good teacher use audio-visual displays to merely enrich a textbook treatment; rather, a pertinent audio-visual display is often employed to make the basic presentation of a subject and printed material is then used in a supporting role. With the ready availability of computer services in the new-type instructional environments, suggested economic models or proposed physical models may be simulated for analysis and for verification. In general, the kinds of instructional environments that a school or college create should depend very strongly upon the emphasis that are planned in curricular content and in instructional method. Again, proper planning becomes fundamental.

Virtually by definition, a modern institution of higher learning is expected to carry out significant studies and investigations and provide public services that are within the institution's capability. It is doubtful that any critic of our colleges and universities or any institutional representative would disagree with the principle that teaching is the prime responsibility of an institution of higher learning. But the kinds of studies which the institution provides its students and the extent and kind of institutional endeavors in other commonly accepted areas of responsibility must vary according to the institution's resources, policies and traditions. Certainly the entire program of a college and university deserves the most careful consideration: the program cannot be permitted to grow in an uncontrolled manner. Too often in recent decades, I regret to say, the ready availability of special funds from private and governmental sources has determined significant aspects of an institution's development rather than a carefully conceived policy; this trend is responsible — more so than many persons may understand — for the growing financial embarrassment being experienced by an increasing number of institutions of higher learning. The very complexity of modern society, with its changing human and physical requirements, intensified the mandate to each college and university to indulge in the kind of careful and systematic planning that is a characteristic of any successful enterprise. And, I must continue to emphasize, planning of program — whether in school or college — must precede any planning of facilities or any construction of need for technological resources.

To facilitate the conduct of programs of continuing education by either the schools or the colleges, we can anticipate the availability of more television equipment designed specifically for educational usage. Opportunities available to us through the more extensive exploration and utilization of the 2500 magahertz band, and then the laser, will enable us to considerably expand our endeavors. Types of associated equipment, such as student response systems to be used in connection with instructional television and also as an adjunct to traditional lecture hall equipment, are now in advanced stages of development. Moreover, new-type color cameras that have been introduced in recent weeks make it economically practical for instructional television programs transmitted within school systems or on campus by closed-circuit systems to be produced in natural color. Educational television is no longer regarded by industrial designers as a mere stepchild of commercial television. It is my judgement that educational institutions have been amazingly myopic in their analysis of the experimentation with possible uses of television; some institutional officers have failed to realize that television is a new and powerful medium that when properly synthesized with other media can often be used in a potent way to facilitate the learning process.

A college or university program of research and investigation, possibly unrelated to its instructional activities, must be the result of very careful planning and must be subject to continuing evaluation. As already indicated, false and undue emphasis upon such a program can play havoc with an institution's perspective upon its total responsibilities. In general, I may emphasize, the extra-curricular efforts of an institution, unless there is adequate planning and control, can lead to institutional disorganization and overcommitment of institutional resources.

Some of the major problems now being encountered by administrators in virtually all educational institutions relate to the computer needs that have recently become a significant factor in an institution's program and financial planning. Annual budgets for the use of computer systems in the research programs of several institutions are now in the multi-million dollar range. In addition, the computer is rapidly becoming the dominant component of many of the physical systems which provide the structural framework of the instructional environments already discussed. And the situation with respect to computer utilization, as indicated earlier, is becoming complicated by the introduction of computer-assisted instruction and by a tremendous student demand to learn computer programing and technology.

No physical and organizational problem now facing administrators of our schools and colleges is and will pose greater demands on their ingenuity than the so-called computer problem. Unfortunately, the problem has appeared in their midst in such a subtle way that most institutional executives have hardly recognized its existence. So in many institutions, especially the universities, the organization with respect to computer usage is in an amazingly inefficient state. As a result, computer services provided within such institutions are inadequate and the cost of operation of the computer systems is intolerably high. The typical university administrator is now facing an urgent and a tremendous challenge to put his "computer house" in order. Too frequently, unfortunately, there is a lack of comprehension of the magnitude of the problem. Moreover, I note a disturbing tendency to attempt a solution of the problem without first making a thorough study of the present and future functions of a computer system in the life of the institution; the determination of organization, for example, must follow the determination of function.

A recent statement by the research and policy committee of the Committee for Economic Development[2] contains the following paragraph:

"Technology may be a powerful factor in the achievement of educational goals where the instructional program is planned by competent designers and the instruments are employed by properly prepared and skilled teachers. The use of advanced techniques in instruction can free teacher time for more intensive individual counseling and tutoring and can extend the range of the teacher's influences by enabling a closer relationship between teacher and student. Educational technology can serve as a

vehicle for developing cooperation among teachers and can aid in overcoming the isolation of individual teachers and classrooms that has commonly resulted from traditional patterns of school organization and teaching. A more efficient deployment and specialized use of facility personnel is one of the new instructional technologies and techniques. Educational equipment and methods may disclose new objectives in education that otherwise may have been ignored. The development of new means often influences the judgement of which ends are worth achieving. More effective teaching techniques may be expected to affect both the goals and substance of education, just as improved methods of communication and travel have importantly influenced our values as well as our behavior."

I am in concurrence with this significant statement. But it is of the greatest importance to note, as a supplement to the statement, that educational planning — planning of program and of instructional strategy — must precede the planning of facilities and the procurement of technological resources. Proper planning must also give attention to the economic aspects of the introduction of technological systems into a school or college environment as well as the educational values that may result; frequently it is essential to indulge in complex analyses to arrive at defensible decisions pertaining to the effectiveness and efficiency of combinations of educational resources, both people and things. It can hardly be doubted, therefore, that executives of our schools and colleges and universities are now facing critical problems of planning that are more difficult than ever before in educational history. The development of a new science of institutional management would appear to be inevitable. ■

[1] J. P. Guilford, **Science**, "Intelligence Has Three Facets", May 10, 1968.
[2] Committee for Economic Development, **A Statement by the Research and Policy Committee**, "The Use of the New Resources", July, 1968.

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Technology And Individual Building Facility Planning

We are living in a marvelous era. A well known sociologist has stated that the solution to technological unemployment (unemployment due to the automation of industry) is the continued development of new products and that these new devices will have to be developed at a greater rate than the current high pace of invention. When you examine his statement in the light of recent developments, the prospects are fantastic. For example, eighty percent of the sales of one of our largest electronic firms are products unknown ten years ago. Sixty percent of the sales revenue of one of our great chemical companies projected for 1975 are expected to be from products now in the introductory stage or which are still to be invented. It has been predicted that thirty percent of the sales dollar in the transportation industry is from new products or those so greatly changed as to be considered new. Perhaps, these examples over-exaggerate the current rate of technical innovation but we all recognize the swiftly moving rate of present development. Should the tempo increase, the impact on school building design and the rate of school building obsolesence are likely to be overwhelming.

Purpose

My purpose today is to examine the impact of developing instructional technology in relation to the planning of individual school buildings. In this treatment, electro-mechanical instructional devices currently available are examined, their uses are illustrated and their impact on facility planning is demonstrated. I propose no pre-conceived solutions to the planning problem, but would exhort you to look upon the planning for instructional technology from a problem solving point-of-view and to use the planning process to evolve the needed instructional systems and the planning criteria for building design. Experiences from other schools utilizing similar instructional devices or systems are usually helpful in this process. Cooperative inter-disciplinary planning is also essential. Moreover, there has never been a *time in the history* of planning school buildings when the need for the development of educational specifications has been greater.

I might add that the general outlook toward these systems appears to have changed. The uses of these systems are likely to be more frequent, more deliberately planned and more carefully implemented. Moreover, the growing emphasis on individualizing instruction has developed a demand for new instructional techniques and these new systems have demonstrated that when properly employed they can serve useful purposes both in individualizing instruction and in improving the effectiveness of large group instruction.

Selected Types of Systems

I will discuss briefly six systems which either have been tested or are being tested in schools and which seem to have some promise in the scheme of things to come. These systems have been put together using fairly common electro-mechanical devices, electronic sensors, and newly developed electronic control and distribution techniques. I refer to these as systems because all related parts are coordinated and the different components reinforce each

other. Furthermore, it seems vital that we take steps to systematize our approach to the use of the many media available in the planning and construction of school buildings. These include:

1. Student Response Systems
2. Multi-Media Control Systems
3. Closed Circuit Television Systems
4. Information Retrieval Systems
5. Learning Laboratory Systems
6. Computerized Instructional Systems

These are discussed briefly in the following paragraphs.

Student Response Systems

This system consists of an instructor's console, perhaps installed in a lectern or located on the instructor's desk, and individual student responses, the number depending upon the size of the class group. The size of the class groups served may vary from 30 to 1,000 students. It is possible to include in the system a computer tape recorder which records student responses on a magnetic tape for analysis and study by the instructor.

In using the system, instruction may be presented in a conventional manner usually with lecture and the use of such visuals as may be appropriate. The instructor will ask frequent questions of the students and he may display his questions visually with the use of overhead transparencies of 35 mm slides. The students respond by pressing a button or turning a thumb wheel indicating one of four or five alternative choices. Student answers are recorded on the computer tape. At the same time, the instructor receives an immediate read-out at the instructor's console as to how the class as a group answered the question. This read-out is made possible by means of five meters, located on the lectern, which indicate what percentage of the class has selected each alternative answer. If the instructor is not satisfied with the results he is getting he can review and explain the material again. At the end of the day the computer tape can be processed for use by the instructor in evaluating each student's responses to the questions asked.

A formal lecture room arrangement with a small platform for the lectern or teacher's desk has been used successfully. Sight lines focused on an A.V. screen for good seeing should be carefully considered and wiring to each student station is a necessity to provide a power supply to the student responders. The magnetic tape recorder can be placed at most any convenient location so long as it is accessible for maintenance and the change of tapes without the interruption of the class. It is conceivable that the tape recorder could be remotely located. Tiered lecture-type rooms appear to be appropriate for larger class groups of 75 to 100 or more.

The student response system can be integrated with the multi-media control system to form a fully automated or semi-automated classroom or lecture room for large group instruction.

Multi-Media Control Systems

The typical multi-media system will usually consist of a control console for use by the instructor, a battery of projection equipment including filmstrips, slide and motion picture projectors, an audio program source and a large double screen mounted on the "front" wall of the space. The projection equipment may be either manually or automatically controlled from the instructor's console. The screen is more often a rear projection type, although this is not an essential characteristic.

As indicated, the use of the system can be manually or automatically controlled by the instructor through the control console. The control console has a multiple track audio tape which serves a dual function; it carries the audio portion of the programed lesson on one track and an inaudible signal that automatically controls the operation of the visual projection equipment on the other track.

When combined with the student response system, the audio source and the visual projection equipment (film chain) can be programed for the automatic presentation of a lesson, the students can be questioned and their responses immediately recorded on the dial at the instructor's console and on the magnetic tape for further evaluation. The instructor can override the system at anytime to report or explain a point missed by the students. It is also possible to combine the automatic operation of the media system with a presentation by the instructor, depending on the situation.

The multi-media control system requires space for the instructor's console, a large, well mounted, double A.V. screen, space for the visual projectors (or film chain), storage for tapes, films and programed materials and seating for the number of students in the groups scheduled in the classroom. For large group instruction rooms, a rear projection screen and a projection room adjacent to and behind the screen are appropriate though not necessary. Electrical service is needed to provide the necessary power supply to student stations, to the instructor's console, and to the visual projection equipment (or film chain). Also, space is required for the magnetic tape recorder which should be accessible for maintenance and tape changes without entering the classroom.

Closed Circuit Television System

Closed circuit T.V. has a number of applications which may include:

1. Receiving and redistributing broadcast programs originating externally.
2. Providing instruction for single or multiple class groups with programs originating in the studio or elsewhere in the school plant.
3. Serving as a medium for the distribution of programed audio-video materials to instructional spaces and student carrels.
4. Providing a distribution system for administrative use as display monitors in making announcements and displaying bulletin notices, emergency information and the like.

The essential components of the closed circuit television system are the teaching studio properly lighted and equipped, a control room and its gear, audio and video connections to monitors in instructional spaces and external facilities for connecting other schools, if required in the system. Outlets for video taping and for program origination should also be provided in selected instructional rooms in the school.

In-room TV monitors should be provided at the ratio of one set for each 15 to 20 students mounted preferably on wall or ceiling mounts. Usually 23 inch screens are adequate in classrooms. Seven and eight inch screens are commonly used in carrels.

It may be desirable to plan a media production center for producing graphics, models, mock-ups, charts, maps, prints, or other such aids. Where the closed circuit television system is used as a distribution medium for film,

filmstrips, slides, demonstrations, video tape, laboratory experiments and the like, then an instructional media library for classifying and storing such media is desirable. Office and work space for operating personnel are also needed.

Learning Laboratory Systems

The learning laboratory is an extension of the language laboratory. Its components are the student's audio receiving position, the teacher's console, the remote switching equipment and the program sources. Each student station is equipped with headphone and attached mikes, volume control and the on-off switch. Each station may be controlled from the teacher's console.

Multiple programs are available to each student by dialing a standard telephone dial on the console. The dialing activates the switching equipment which selects from the available programs.

The teacher console allows the teacher to monitor, record or communicate with any individual student station. The teacher may also have the option of communicating with the entire class at once on an "all call" line.

Study carrels used in the system may be equipped for student participation in a variety of ways including:

1. Listening
2. Listening, responding
3. Listening, recording, or remote recording
4. Listening, responding, recording, or remote recording.

A wide variety of subject matter content such as mathematics, music, social studies and science, can be programed for learning laboratory use.

Space for the learning laboratory will depend on the number of stations to be installed. Learning labs with up to fifty stations are currently in use. Most student carrels, depending on dimensions, will require from 18 to 25 square feet per carrel for installation and for student circulation. Space for the teacher's console, the switching equipment, and program sources is also needed. Electrical service to the student stations and other components is also a requirement.

Information Retrieval Systems

Information retrieval systems are an extension of the learning laboratory concept. The system described here is also referred to as the Dial Access System, the Random Access Teaching Equipment System, Select-A-Lesson or the Program Distribution System. The system makes possible the selection of individual audio, or audio-video programs from a central source. Simply by dialing a number on a telephone dial, a pre-selected program, either audio or audio-video, is sent to a student carrel, a classroom, the library, or other space through a speaker, a television monitor or a headphone set or some combination thereof. Study carrels can be equipped for student participation in the same way as in the learning laboratory.

Program sources for use in the information retrieval system may include:

1. Audio Tape Machines
2. Video Tape Machines
3. Live Studio Productions
4. Film Chains for Motion Pictures, Slides and Film Strips.

An unlimited number of programs can be stored and automatically retrieved. The principal limitation is the quantity of originating equipment which is technically expandable through the addition of storage and switching modules. Other major limitations, aside from the financial one, are the preparation of teachers and the preparation of programs to go with the system, in other words, the software.

The components of the system are student carrel or classroom positions, equipped with telephone dial and audio or audio-video receiving equipment; the switching equipment or computer for connection and disconnection; and the program sources. It is possible to incorporate into this system a central control console equipped for monitoring individual student responses or to control student access to remote programs. The control console is an optional component of the system.

Student stations are usually incorporated into study centers, libraries or learning laboratories. In practice, not all carrels are equipped for video programs. In one school familiar to the speaker the ratio of video to audio carrels is about 1 to 1.

A control room is needed for the switching equipment and the remote program sources including the tape decks and the film chain. This space can well be incorporated into a closed circuit television control center and placed adjacent to the TV studio, a service drive or other desired location. Other suitable locations might include an area adjacent to the central resource center or the learning laboratory.

Distribution cables to instructional spaces for large screen classroom monitors and wiring for video screens and audio equipment in student carrels are necessary.

Computer Based Instruction System

This system is also referred to as computer assisted instruction (CAI), computer administered instruction (CAI), and computer mediated instruction. In this system the student receives instruction directly from the computer through input-output devices. A live teacher may or may not be required. In this system the computer enters directly into the learning situation. Programed materials are stored in, and presented by, a computer.

Educational uses thus far have included: (1) drill and practice, (2) tutoring, (3) simulation and gaming and (4) information retrieval. While the number of schools experimenting with the system has increased, it seems safe to say that the use of computer based instruction is still largely experimental.

A number of universities are exerting leadership in the development of computer-based instruction. Six of these include Florida State University, Pennsylvania State, Stanford, University of Texas, Harvard and the University of Illinois. Other universities are joining this group of innovators at a rapid pace.

The components of this system may include a student station consisting of some combination of a headphone set, a typewriter console, a cathode ray tube and a keyboard, a control console which receives and sends student responses to the computer, a computer, and the program storage device which may be a magnetic tape or magnetic disc.

Each student has the capability of communicating independently with the computer by entering into the keyboard device a student number or his name. The computer program will ask the student a question or give him directions. The student will respond by typing on the typewriter, punching a keyboard, talking into a microphone or shining a light pen on the cathode ray tube. The system has branching capabilities and can repeat itself on request. A student may take as long as necessary to respond to a question. The computer checks the student's answers. If correct,

it tells the student and gives him another question. If incorrect, the student is told and is asked the question again.

The computer also has the capability of providing a print-out of the students performance for given periods of time. The computer can keep track of right and wrong answers. Through such print-outs from the system, it is possible to determine which students are having difficulty and the areas in which they are having it.

Facilities requirements will include:

1. Space for the number and type of student stations depending upon whether they are typewriter consoles or the cathode ray tube keyboard unit.
2. Space for the computer and its components (equipment room).
3. Raised flooring throughout student and equipment areas for cables, etc.
4. Adequate electrical supply service.
5. Special lighting for student stations with cathode ray tube equipment.
6. Air conditioning and the regulation of humidity in equipment areas.

Impact of the Learning Systems

The impact of the systems on individual building planning can best be seen by observing some concrete illustrations of cases where these systems are employed in the instructional program. I have chosen for illustration: the Nova High School Plant which is a part of the Southern Florida Education Center in Broward County Florida, the Infantry School Training Center in Fort Benning, Georgia, and an automated classroom for teaching Driver Education in Athens, Georgia.

Nova High School

Nova is an experimental six year high school. Some of the interesting aspects of its program include:

1. The Trimester Plan
2. The Continuous Progress Curriculum
3. Team Teaching
4. Use of Data Processing
5. A school day comprising five 70-minute periods plus an optional early morning period.
6. Modular Scheduling
7. An Information Retrieval System
8. Individualized Instruction
9. Multi-Sensory, Multi-Mode Approach to instruction using technological instructional aids.

Nova is a campus style school with individual buildings for language arts, science, mathematics, and technical science clustered around a large multi-purpose patio area. Other buildings include the administration, music, and physical education facilities. Facilities included are a decentralized library, multi-purpose classrooms, convertible space lecture halls, conference study areas, individual teacher work areas, departmental offices, open-space science laboratories, closed circuit television control center, learning laboratory, wet and dry carrels, TV studio, and a center for the preparation of visuals.

The forty major instructional spaces are equipped with a 23-inch television monitor; 8-inch monitors are in 18 of its resource center carrels. A closed circuit TV system is capable of piping 10 different programs to a maximum of 70 different stations. Upon request via direct-line telephone from any teaching station or resource center, the TV control center is fed simultaneously to any classroom or carrel monitor two programs from broadcast, two from video tape, one from its mobile camera (from an instructional station in the complex), and two from its multiplexer (film chain), which can utilize 16 mm movie film, 35 mm slides, and 35 mm filmstrip.

Sixty-six classrooms and carrel stations are equipped to receive audio programs from the control center's 24 tape decks. The retrieval of audio programs is automated. Students dial the appropriate number on a telephone dial in a carrel to receive music, language lessons, recorded lectures of an instructor or other information.

In the learning laboratory, the instructor can channel one of four audio tapes to each of 50 carrels in the room. He can also communicate directly with each student.

Two trapezoidal, 200 seat, divisible large group instruction rooms are provided; one for language and one for mathematics and science. Each can be divided into one 100-seat and two 50-seat rooms. Both are equipped with projection booths, large multiple screens, a TV projector, and other media equipment. A media control console is located on the platform.

Other building features include:

1. Each teaching station equipped with overhead projector and mounted screen.
2. Triangle shaped-middle rooms with tiered seating arrangements and folding partitions that permit enlarging and dividing space.
3. Access to the data processing center at the junior college by Nova.
4. Air conditioning on a year round basis.
5. Carpeting in many areas of the plant.
6. Quest centers provided for use by students.

United States Infantry School Facility

This center has two facilities of interest – an automated classroom using the multi-media student response system and a computer supported instruction laboratory.

The Automated Classroom

The automated classroom facilities include the control console, a film chain, the large rear projection screen, a tiered large group instruction room with 200 seats, and a computer magnetic tape recorder.

In the operation of this unit system, the audio portion of the program is recorded on one track of a two-track magnetic tape. Electronic data signals are recorded on the other track. These signals control the projected visuals which support the audio portion of the program. An audio tape deck, mounted in the instructor's lectern transmits the data signals to a projector control box which then controls the projectors in the presentation of the visuals in a predetermined sequence. The data signals turn the film on or off and switches the audio from the sound track to the motion sound track and back again. During the presentation, frequent questions are asked which each student must answer. Students answer by using a student response unit located at each station.

Student responses are recorded simultaneously at the instructor's console and on the computer tape. The reading at the instructor's console indicates how the class as a whole responded to the question. If the percentage of the class selecting the right answer is low, the instructor may stop the program and reteach the material missed.

At the end of the day the computer tape is removed and processed through the computer center. The hard copy

prints-out lists exactly how each student performed on each question, what percentage of the class selected each alternative and the precentage of questions asked which each student answered correctly.

Computer Supported Instruction Lab

The lab contains 200 stations equipped with 50 cathode ray tubes and keyboard (consoles) connected to a remote computer. Each student communicates directly with the computer. The computer asks the students questions. The questions are answered by a student by depressing the keys on the student keyboard and pressing the transmitter key to transmit his answer to the computer. The computer checks the answer by the student. If correct, it tells the student and gives him another question. If incorrect, the student is told what he did incorrectly and the question is asked again. The computer keeps track of right and wrong answers. At the end of a given period, the computer can furnish information about the performance of each student.

Lucy Cobb Student Response and Multi-Media Control System

The facility was built in 1858. The system has been installed in remodeled space. Floors are carpeted. It is air conditioned and well-lighted. This system is used to teach driver education. Its components are the film chain, a rear projection screen, a projection control box, the instructor's media control console, a tape deck, and the student stations with student responders. The system is exactly the same as that described for the automated classroom at the Infantry School except for the computer capability and, of course, it is a smaller application and less sophisticated.

Summary and Conclusions

Six learning systems currently being used or tested in our schools have been described and some implications for building planning discussed. These learning systems have great potential for aiding individualized and large group instruction when there is proper application in the instructional program. They are subject, of course, to the usual mechanical and related problems.

In planning for these systems, the following should be kept in mind:

1. These systems are in the early stages of development and are likely to become more efficient, less expensive and more sophisticated.

2. An inter-disciplinary approach in the planning of these systems is a must.

3. Their application and use in the instructional program must be carefully determined through appropriate curriculum development studies.

4. Educational specifications must be prepared as the medium for assessing need and communicating the instructional uses as well as system components to the architect.

5. Careful and perhaps extensive instruction in the purposes and uses of the systems installed in a new school plant is essential for the teachers who are to use them.

6. Plan for these systems in new schools by making provision for power, sound and video distribution, and all-band terminals.

7. Systematize the approach to the use of the needed system where possible and plan ahead for their potential future use. ■

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Technology And District-Wide Facility Planning

This fall, suburban areas of New York reported an unprecedented demand for housing from people with children, a demand really out of all proportion to the usual experience. I suppose what happened is that those who could pay were willing to pay a great deal so that the education of their children would continue without interruption.

Another isolated fact is that in many areas there is an upward shift in the yield of school-aged children per dwelling units in apartment houses, even high-rise apartments. Ossining, New York, for example, has studied a whole group of six-story apartments over a period of years. The building of apartments looked good financially for the town at the beginning of the study. The yield of children was low and a tax return was greater than the actual expenditure occasioned by the apartments. In the last few years things changed. The yield of children of school age has increased much faster than the financial yield.

Another isolated fact is that in Pelham, New York, ten years ago, a yield of .47 public school children per house was found. Last year, the yield was close to .57. For all practical purposes no houses were built in the school district in that time. The parochial schools experienced proportionately the same increase. Fifty per cent of the houses still do not produce children who attend either private, public, or parochial schools.

In thinking about long-term planning of a school district and its facilities, these kinds of random fact may be, if we knew more, related and possibly predictable. Much of our information is incomplete. The availability of data processing equipment may mean that some day we may make a significant breakthrough in our ways of forecasting. Our procedures now can only, with a great deal of kindness, be termed primitive. Perhaps, too, we shall require more searching tools for this kind of inquiry when we run out of urban sprawl and must come back and look into existing communities, places where people have lived for a long time and where change takes place even though it is not physically obvious nor easily discernible.

We have been working around in this area for some years, as have a number of other people. I think you eventually get to the point where you realize that no one really knows much about the ways people use dwelling units nor is much really known about what I suspect is a cyclical nature of yield of school children per dwelling unit. We simply do not have enough information to make any kind of intelligent conjecture about yield from data about the quality of house, age of house, size of house, house or apartment, income levels or what have you. We cover the knowledge gap with a layer of glittering generalities.

With effort and data processing equipment, it would be possible to accumulate information in manageable form. Such a move would be small, simple, and useful. Given information, we could have a better base for prediction. Who knows, we might go so far as to learn how to predict the future from present conditions and not from hindsight alone. We could even perhaps come to the day when a measure of the quality of a city would be a viable base for estimating what would happen to the city in the future. Do you remember Thorndike's work in this field?

A second major area that I would like to comment on is in the field of communications. What happens to a school system when a group of high-powered citizens look at the way the school uses the new media for communication of ideas? In Evanston, Illinois, the elementary school district under Dr. Gregory Coffin's leadership got just such an operation going. The report of the Committee not only gave strong leadership to the use of newer media but resulted in developing considerable community support for the effort. This same district used data processing equipment in its successful integration of schools several years ago, fitting

racial balance into the system with a minimum of disturbance and a maximum amount of basic good accomplished.

Communications systems go beyond closed circuit television and even the relatively sophisticated information retrieval systems that are coming into operation. The data processing equipment is a communications tool and its use in computer-monitored instruction is completely possible today. Computer-assisted instruction in any significant mass basis seems a bit remote at the moment.

Retrieval systems are fanning out and Dr. Newsom's remarks about low cost color TV were not lost on his audience. Parenthetically, much of the best software is student work. I saw a report in the retrieval system at the Bedford Middle School done by three sixth graders and dealing with the scientific aspect of clouds that was a real virtuoso job. Software, expansion of systems, sharing programs such as the Beverly Hills, Evanston Township High School, West Hartford axis are all real and fairly accepted practices.

What these communications systems are doing is much more basic. Properly used, the systems can make the teacher vastly more effective until the teacher is no longer recognizable. While schools used to operate out of textbooks, and a few still do, the textbook manufacturers contemplate instant texts made up by prescription overnight. The Buck Rodgers (for the old ones) and Star Trek (for today) aspect of the communications revolution will not go away. The nature of the school, of the system, and of the roles of teaching and learning is moving so rapidly that the kind of physical planning needed must be a basic and reflective look at who or what can do what task best and, as a result, how do we house education?

I think we are at the point in time where teachers are going to stop talking at people. A great deal of time will be devoted to prescription of materials and things to do which must be done in terms of individuals if, indeed, we mean that we are going to be concerned with the education of individuals. We have built in, I think, this tremendous potential of a technology that allows us to distribute anything. We should deal with the problem of the diversity of things that ought to be distributable. I think that you will see in almost any system – a college, a system of schools – an area in which the development of such material and the propagation of these materials from one point to another will assume very large proportion. Where it exists or where it would be, I don't know. But I think that we must sooner or later get to the point where these materials are not only available but are originated by students and by faculty. Once they were originated by students or by faculty, I think they would tend to be more appropriate to students who are using them.

Then the last point – the use of games. All of education is a kind of game. It's simulation. We have a tendency to set our point of view toward education in a quasi-religious ceremonial pattern. We have an elaborate series of rituals that we expect children to go through because it is good for them. We lead them to the ultimate distinction of being awarded a degree, a diploma, or else we arrive at that great point in life, the peak of guidance, when that good homespun guidance counselor puts his arm around the student and says "Son, have you ever thought of becoming a dropout"?

Those of you who have had the experience of playing the game of planning that exists here in Washington in the Center for Metropolitan Studies know that taking part is a great experience. The players in the game accept roles as members of groups who own property, have some money, and get into the act of the entrepreneur and his role of dealing with the growth and development of towns and regions. The involvement of a group of social-worker, do-gooder types in the entrepreneurial system seems to cause them to lose some of the veneer of things they have learned and sometimes the absolute beast comes out in them. I remember the point when the architect, Albert Meyer, rose up and asked "Why doesn't somebody say something about beauty instead of all this nonsense about money"? A wonderful response in a simulation.

Arthur Shapiro out in DeKalb, Illinois, and I were stimulated by the planning game so we have been writing our own simulation. I mean that Dr. Shapiro has been writing it and I've been encouraging it. We ended up with the beginnings of what can be a good one in which we actually tried to simulate a faculty, Board of Education, and Superintendent dealing with the problems of how to redeploy staff.

Simulations are pressure cookers. They compress time and they build pressures, and they have a cumulative amount of pressure because what happens one year must be dealt with again the next year. It is a little bit different from the situation where you may be dealing with the in-basket, out-basket thing, which is dead you know. The simulation doesn't leave you with that dead fish kind of feeling because it is alive and it snaps back at you. You have to live with your mistakes. The simulation that we have been working with really has put the district under financial pressure. There are ways out that we control carefully. You find your way out only through my maze, not yours.

Another simulation that I think of was Lewis Yoho's. Lew Yoho runs the School of Technology at Indiana State University in Terre Haute. Yoho has actually tried to develop simulations in which he deals with manufacturing enterprises of one kind or another. I saw this kind of thing happen. For example, the simulation was a group of five students – tenth graders – looking at a series of photographs of a Bucky Fuller dome. The photographs were sufficiently vague, purposely, so that no one could tell how it was put together. With an instructor they talked about this and finally took on the task of designing, inventing, manufacturing, packaging, and considering setting up for marketing the connector of the geodesic dome. Kids tumbled at the fact that this was the key. So they went to work and it was interesting to see them operate because they started out with a piece of open space in a laboratory. The first thing they did was to go to the library and try to find out what they were talking about. I would view anything in the industrial arts-vocational/technical area where students do this as being innovation of the highest order. The students, having brought material back, needed a bookcase so they got one. The stuck it on the floor in their place. They moved on. The found ideas. The sat around a table which they pulled out of a store room and pretty soon they had some ideas going. They began working in designing and drafting, if you would. They finally set up a production line and by the time I last saw the group they had the thing under production and they were working on how much

labor it took, the materials, and the packaging.

I suppose that was quite a successful operation. But then they added the other element – the kicker. The original students took some students who had not been involved in this simulation and put them into the system – inserted them in, plugged them in as laborers along the line. The great thing happened when one of the kids observed that "this is a lousy connector." So the students stopped the lines at that point and went back and started over again to improve upon what they had done. I think that one of the things this suggests is that sometimes the only place where we really are intelligent about the uses of people is when we do something important in education, that is, when we have a football team or a band. No one in his right mind would ever operate these as a completely graded system.

The simulations are indeed a way of learning things. They can teach skills and facts in the context of having to use them in a significant situation where, if you don't use them well, you look like a fool to your colleagues. This, I think, is one of the great motivators. On the other hand, the participants also gain insight because it is a game an no one is personally involved in a game.

In our big inner city communities there is almost a total separation of the people in the community from their ability to do anything. New York City now is finding incredible difficulties in allowing 300,000 people in their Brownsville area to make some decisions regarding their own salvation, their own course of education. Forty thousand people in Scarsdale can do it, but 300,000 people in Brownsville aren 't allowed – they are second-rate people. The problem, then, of getting people involved in deciding upon their own future, it seems to me, must relate to their experience and, hence, their opportunities in decision making. If communities have not had experience in decision making, it seems to me simulations might be very useful, involving people in the process of making decisions without the immediate consequences.

Perhaps if the Brownsville community board had dealt with the union in simulations for a time, both sides would have been able to avoid the impasse they are in. Community and teachers would have found other and acceptable ways to get unsympathetic teachers out of the schools without loss of face on either side. It takes a little time to learn a sophisticated way of beating the system.

I think further that if you were to look at the planning process for facilities in the inner city, it is conceivable that it would be possible to create some kind of simulation in which people in a community could make judgments about the kinds of schools they want and about the kinds of facilities they need. Or the citizens could turn the game around and make it a tryout. Ordinary people working with the teachers and principals of an area would be able to try out a series of ways in which you would outfit space and I daresay you could get a computer to print out a diagram or flow chart of what you were talking about. It would be the kind of schematic diagram or flow chart that might be illuminating. In this way, people who are not very sophisticated could go through a planning procedure and acquire experience in doing this without having it cost anything. Ultimately, the community participants could help make better judgments because they, too, would have had experience in making judgments.

In the district-wide planning process, we can use technology as a base for simulation, finding ways in which we can more deeply involve people. Don Leu suggested this really in a simpler form in Detroit where community areas might be involved with thinking about what their schools would be like. Out of some kind of a focusing of energy made possible by technology, it would be possible to get at least a portion of the people of a community significantly involved in the planning process. I daresay that the inner city would do just as well as anybody else at this task and indeed we might learn a great deal from citizens in poverty areas in terms of those things that are important in the inner city – things and attitudes that the white middle class teacher so far, generally, has not really understood. They are:

1. The use of facts and how they can be assembled and focused on problems to make planning more intelligent.
2. The use of communications technology so that the teachers can indeed individualize programs.
3. The use of the planning process itself through its technological components to assist in developing attitudes in people.

In summary, technology applied to districtwide facility planning makes these three contributions, among others:

1. More significant acts can be assembled and deployed to give a better basis to decision making.
2. More individualization of educational programs may be possible through the communications media of technology, shifting in a major way our space needs for learning.
3. More significant participation by citizens in the planning process through the role that technology can offer in simulations. ■

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Technology And Community College Facility Planning

Community need and the automobile create the community college idea. Without automobiles, the whole idea of the non-residential college wouldn't exist in its present form in twentieth century America, except perhaps at the centers of large cities where students could commute by public transit. The front door to the community college is usually the parking lot. Students arrive in automobiles from their homes, and the automobile is one of the important links relating the college to the citizens. The community college, therefore, is responsive to local needs.

This is in contrast to the college or university that is not a community enterprise, but rather a statewide, or national, or even worldwide facility. The residential college is often separated from its immediate community—more so in the past, but, fortunately, less so today. Also, the residential institution's character is strongly influenced by years of tradition, and it often resists innovation.

The community college, which tends to become the community cultural and educational center, serving all citizens, is a new concept for higher education. The idea is still developing; the rules have not yet been written and formalized; it is free from limiting traditions. New ideas are welcomed and new programs are continually evolving. Therefore, a high degree of flexibility in its facilities is particularly important.

The demand for flexibility.

The old college forms that we grew up with are inadequate. They are inadequate for a world experiencing social change, economic change, political change, technological change, and changes in the character of teaching and learning.

Education for what? Look at the world around us. Note the changes in what men work at, and how they do it, and where they work. In the electronics industry (where change is a natural characteristic of work) the prominent Dallas firm, Texas Instruments, builds "sandwich" structures with service floors (for structural support, mechanical, and electrical systems, support facilities, etc.) between huge unobstructed and "uncommitted" work spaces—spaces that are readily adaptable to new and unpredictable tasks. In medical research, the Salk Institute labs at La Jolla, California, uses similar space—alternating "service" floors with "served" floors, to achieve a degree of flexibility not known to (or needed by) previous generations. Education, now, also needs that kind of adaptability.

Engineering schools have found they need it. Consider the typical American university's engineering school. It is served by a number of separate structures, each one belonging to a "department." Now, however, the nature of engineering education has changed, and the old departments and old buildings have less meaning. The design of a rocket-launcher combines, in the best multi-disciplined manner, all of the old labels—chemical engineering, electrical engineering, mechanical engineering, aeronautical engineering, etc. The design task becomes "engineering" in a broad sense, with heavy input from the life sciences, mathematics, astronomy, etc. Southern Illinois University's new School of Technology at Carbondale, attempts to satisfy future needs by creating large unobstructed and uncommitted floors with structure and circulation at the perimeter, along the external towers to accommodate stairs, elevators, toilets, and mechanical-electrical services.

The modern office building achieves a high degree of flexibility with a different system. A central core accommodates all services, while the exterior wall satisfies all additional structural and mechanical needs. The resulting space around the core is column-free and totally uncommitted. Tenants subdivide the space to suit current programs. The office building space concept, a marvel of adaptability, can be useful to education.

Does the education process really need this kind of flexibility? I think so.

The crystal ball is never crystal clear. We cannot predict how teachers and students will use the spaces we design today; we cannot predict what kind of equipment they will wish to use. For example, the library of tomorrow will probably incorporate information storage and retrieval systems not yet invented, but basic structural shells, today, must be designed for generations of use. We are currently designing a library in Bloomington, Indiana that will store half of its collection of 600,000 volumes in a Sperry Rand "Rand-triever" system. When a person asks for a volume at the desk, the computer is consulted, and if the volume is "in," the machine plucks the appropriate tray from the storage stacks and delivers it to the desk, and the computer records the fact that the volume is now "out." This is a modest system compared to some of the proposed information storage systems. The point I wish to make is simply that the need is intense and man will not stop inventing new ways to satisfy his needs. New kinds of hardware will appear and the buildings we design today must accommodate unknown future devices and programs and space needs.

The community college in the suburban or rural setting.

The community college is similarly affected by changes in the world around it, and it frequently finds itself intimately involved with urban problems and opportunities. First, however, let us consider the college in the suburban or rural location, where life appears to be halcyon and where the planning process is indeed less complex.

California and Florida were leaders. Foothill College, south of San Francisco, in a low-density area of houses with low, pitched, shingle roofs and beautiful gardens, has a campus composed of dozens of house-scaled buildings of residential character, in a spacious garden setting. It was then, and is still, one of the most beautiful colleges in the world. For planners of community colleges, it became Mecca.

North of San Francisco, across the bridge near Muir Woods, the Marin County College achieved a successful environment without the benefit of consistent or distinguished buildings. Its secret to success was thoughtful landscaping; the spaces between the old and ordinary buildings show the benefits of years of care in planting and maintaining fine gardens. Many other colleges could learn something here.

Not all California colleges are gems. Many, particularly in earlier years, were ordinary, or looked like high schools. That was also true in Florida. My first experience in planning a community college was at Fort Myers, a few years ago, for new Edison Junior College. The State of Florida education planners observed that all previous campus plans in their state had low, flat, small, separate buildings, widely spaced. They suggested that we consider clustering closely-related multi-floor buildings—to achieve convenience, economy, shelter, and the spirit of higher education. We (McBryde and Frizzell, and The Perkins & Will Partnership) developed a straight forward system for the first facility and for future growth. First Phase construction involved a modest expenditure—only $1 million for two multi-purpose structures—each two floors, with open bridges connecting their second floors. The basic character of the campus was established with sheltering roofs, linked units, gardens, perimeter lakes, etc.; growth occurs by adding multi-floor structures inter-connected by second floor bridges. First buildings provided flexible space, since all campus functions had to be incorporated within them in early years. As the college grows, additional buildings of a more commited nature are to be added.

An important planning principle was adopted: the nature of the master plan is such that future facilities can change in size, shape, and location, to allow constant adjustment to changing needs. It is a sobering experience to go back and examine the formal and rigid "master plans" prepared by earlier generations.

Now, Florida has some handsome community colleges. Miami-Dade North, and the newer Miami-Dade South junior colleges (both designed by Pancoast, Ferendino & Grafton) are impressive, large-scale campuses designed to accommodate 10,000 students each ultimately. Miami-Dade South was located in an undeveloped area south of the city, but on a site served by new expressways, and it is obvious that the metropolitan urban area is rapidly growing out and around the new campus. Good planning!

In Texas, the Dallas County Junior College board has a plan for seven campuses. Dallas County is a tidy square, 30 miles by 30 miles with Dallas at the center, and with expressways radiating out as spokes from the hub. At the hub, the first "campus" exists—it is "El Centro" which occupies an old department store which has been skillfully remodeled. Three new suburban campuses are being planned now—and three more are projected for the future. Each of the six 5,000-student college campuses is approximately equi-distant from the hub, out on one of the spokes. This will be an excellent example of a large system of colleges. In the future, they will be tied together, and related to their 900 square mile county community by the expressway system and by media. We have been working (in association with Enslie Oglesby, architect) on the design of Richland Campus, with President Bill Priest and his team. The campus, part of the larger system, will be subdivided into small learning "clusters." The various clusters on the campus will share certain common facilities—theater, fine arts facilities, gyms and pools, and library. Although Dallas County may eventually have 35,000 students in its junior college, they have wisely resisted the temptation to plan a campus that large.

The emphasis is on the individual student, his relationships to a relatively small number of other students and teachers of his own cluster, then his relationship to one campus, and finally to the total seven-campus system.

The Richland Campus site in Dallas County is blessed by a chain of three narrow lakes, separated by dams. We chose to develop rather informal but linked buildings on both sides of these lakes, letting the lakes and gardens create the principal visual environment. Although all interior spaces are, of course, air conditioned, the natural environment (water, trees, plants, clouds, the changing daily climate and seasons) is an important part of the design concept.

In contrast, there is now considerable interest among architects to design "mega-structures"—hung multi-story loft-like structures, often with roofed controlled-environment "great spaces" replacing the traditional yards or gardens. Such dramatic interior spaces are becoming an accepted part of our experiences. Note the trend in shopping center design to create air-conditioned malls. Each community college should determine whether the single-structure concept (especially when it is formal,

rectangular, and "finished") will meet its future needs. Such a structure probably can provide a high degree of interior flexibility, but resists the external addition of space, especially in small increments.

Scarborough College, northeast of Toronto, is a single-structure, or continuous structure campus—or perhaps we should say it consists of a number of adjacent structures, along a single interior circulation route. The Canadian climate encourages such a design. Students move from one part of the campus to another without going outdoors. This could have been accomplished in one great rectangular loft-like building, but Scarborough College is based on quite a different concept—it is a long, complex, winding building in which one encounters many different kinds of spaces as one walks from one end to the other. Raw concrete is the principal construction material; on a sunny day it is attractive; the bold and complex forms are agreeable on the beautiful wooded site at the top of the ridge. Our Canadian friends have completed, and are building other fine new colleges. Note York College, also near Toronto, and Simon Fraser, at Vancouver.

Another commuter-college (though not a community college) of interest is Southern Massachusetts Technical Institute near New Bedford, Mass. Architect Paul Rudolph's design is dramatic and systematized, skillfully creating interesting exterior and interior forms disciplined by a modular system of large hollow columns and girders which serve as distributors of conditioned air and utilities. Massachusetts fire safety laws demand that corridors in multi-story buildings be interrupted by separate stair towers at regular intervals. Rudolph has turned these necessary exit spaces into wonderful red-carpeted lounge-like gathering places for students. Each has the fine warm character of a ski lodge—an environment that students obviously like. Such spaces are important for the commuter-college in the country where there are no other places for students to go. S.M.T.I. does it well. Lacking such social spaces, the college in the rural or suburban setting often fails to give students the rich and varied opportunities for informal association that the urban campus naturally provides.

The community college in the city.

Today, most students feel that the city is where the action is, and many of their interests have to do with urban problems and opportunities. The community college in the city, therefore, has special opportunities. Planning the urban campus contrasts sharply with planning the campus in the country.

The campus on a rural or suburban site creates its own environment; it tends to be self-contained. In contrast, the urban campus is often a part of a total urban environment. Neighboring structures and urban spaces help create the college's physical environment.

Land in the city is in short supply and is therefore expensive. The spacious lawns and woods of the rural campus are usually neither possible nor desirable goals for the urban college. In high-density neighborhoods, agreeable open spaces are urban in nature, being smaller, and well-defined by surrounding structures. Urban building forms are natural and appropriate—multi-floor or even high-rise elevator structures, large loft buildings, underground facilities, air-rights development, etc., are all economically sound possibilities where land is expensive.

Many interesting urban university examples can be noted to dramatize the urban land problem. Fordham's new campus on Manhattan Island, one block adjacent to Lincoln Center, has a large new skyscraper (in the spirit of the modern office building) which accommodates classrooms, laboratories, and offices. Roosevelt University occupies an eighty year old structure on a half-block facing Chicago's Grant Park; it is Adler and Sullivan's famous Auditorium building. Stephens Institute of Technology, at Hoboken, N.J., has a ship tied up at their dock on the Hudson River; it is a floating dormitory. The University of Illinois' Chicago Circle Campus, near the Loop, is a multi-level campus, with pedestrian walks elevated above service drives, streets, and lower-level lecture halls; a twenty-eight story office tower is a visible landmark in the city.

Urban community colleges are also taking new forms. In Oakland, California, the multi-campus Peralta College district is building Laney College downtown, with all buildings on a site of about ten acres. Architects Skidmore, Owings & Merrill have placed all facilities—library, student center, physical education, lecture center, a six-floor administration tower, and classrooms on top of a large square one-story base structure which accommodates laboratories, shops and services. In addition to this urban site of ten acres, additional land was acquired through the federal open space land program to create an adjacent public park, and other parcels of urban land provide parking. Oakland's new art museum is adjacent. The new community college becomes an important urban renewal component, and a stimulus for additional renewal of the city.

Chicago City College proposes to build a number of new colleges in the city. One will face the Eisenhower Expressway (with rapid transit in the median strip) with the huge West Side Medical Center across the expressway. This campus, designed by C.F. Murphy Associates, will consist of a single, four-story rectangular structure, approximately 500 feet long, on a limited site surrounded by the gridiron streets of its urban neighborhood. Physical education facilities, auditorium, library, lecture rooms, cafeteria, and laboratories will occupy the interior spaces in this mega-structure, and classrooms and offices will be located around the perimeter. With a rapid transit station adjacent, the campus will be accessible to all parts of the city by train, so large student parking lots will not be provided. Hopefully, the parking lot will not be the front door to this commuter college.

Chicago City College Chancellor Shabat and Dean Slutsky are planning another campus for Chicago's south side on a site split by Wentworth Avenue. Three multi-floor bridge-buildings will span across Wentworth Avenue, connecting other facilities located on both sides of the avenue. This is a logical urban development which recognizes the existing patterns of land ownership, streets, and utilities. In Oregon, Portland State College has grown from an older ex-high-school building to adjacent blocks by bridging city streets with pedestrian walks connecting all third floors. Three-dimensional planning is appropriate in the city.

The next step in this evolutionary process is obvious. The community colleges can bridge the new expressway, knitting back together the urban neighborhood that the expressway cut apart. The federal Bureau of Public Roads

now encourages the concurrent development of the banks alongside of, and the air-rights above, new depressed expressways.

With coordinated planning involving highway departments and colleges and other public and private groups, the highway people can acquire and clear (using their rights of eminent domain) land not only for expressways but also for educational facilities. If you wish to visualize future college facilities bridging an expressway, I suggest that you visit the restaurants spanning across the Illinois Toll Roads. They are handsome, dignified, and quiet places. The technical problems have been solved. Highway planners now wish to help us solve the legal problems. The economic questions can be answered by analyzing the cost of urban land as related to additional costs involved in bridge construction.

I would like to give you one more air-rights example, using a community college project my associates and I have been planning. Grand Rapids Junior College occupies a seven-floor structure at the edge of the downtown business district. Even though land is rather expensive, adjacent property needs renewal. On the block across the street from the existing college building, we propose building a 1,000 car parking structure with an extra top deck which will become the campus Forum—an urban plaza to become the new focal center of the college. Pedestrian bridges across the street will connect the Forum to the fourth, or middle floor of the seven floor building. Future student center, library, theaters, and other buildings will be located on and around the Forum. Obviously, planning of this nature in the city requires cooperation by many city government agencies. The college has also worked closely with the private cultural agencies of the city towards making this the community cultural center. The design intent is to create, at the center of the city, an urban environment for many of the educational and cultural activities of the total community.

The idea of developing the community college at the heart of the community is also applicable to smaller towns and cities. Consider the typical American county seat—whether 5,000 to 50,000 population. I think of Princeton, Illinois; Warsaw, Indiana; Marshall, Michigan; or Newark, Ohio. Instead of buying 300 acres of farmland at $500 an acre and proceeding to spend $10 million developing the property, the community college has another option. It can use that money to help redevelop its existing community, downtown, near the courthouse, bringing new life to its business and cultural center. It can mix the colleges into the community. It can effectively utilize certain old structures with economy—saving older buildings that have merit—and replace inadequate old structures with new construction. The college will expand and grow naturally, over the years, as a part of the community, not set apart from it. The college will be most convenient to both teachers and students who choose to spend part of their time "on the campus" and part of their time working. It will truly be a **community** college.

In praise of old buildings.

Although many old buildings do not serve today's needs well, and cannot be economically renovated, occasionally an old building has excellent potential. Evaluation should include structural, legal, economic, and cultural considerations. Boylston Hall, in the Harvard Yard, was worth saving. It is 110 years old. On its 100th birthday, Harvard decided to completely rebuild the interior, saving the fine granite walls, slate roof and ancient trees. The Architects Collaborative skillfully designed a new interior, adding an extra story within the handsome old shell. TAC gave it a new floor system, air-conditioning, plate glass in bronze frames, and fine new furnishings. The cost of the new space was considerably less than what an all-new building would have cost—and the resulting space is better than that found in some of the recent buildings on the campus. Time was saved and an important landmark was saved.

Knox College enjoys a similar facility. Old Main was the scene of one of the Lincoln-Douglas debates. In 1937, the interior was rebuilt, and it has been remodeled again in recent years. Today, it is a superb administration building.

Given the proper circumstances, the community college can utilize an old building successfully, I mentioned the Dallas County Junior College's downtown campus which they call "El Centro." The college acquired an abandoned department store that no one wanted, by purchasing the land. They converted it into a fine downtown "campus." Architect Oglesby removed street-level display windows to create a sheltered arcade around the building, and utilized the spacious ground floor for the new college lounge, bookstore, and cafeteria. New open stairs provide direct access to the second floor library and basement recreation spaces. Existing elevators are crowded but acceptable for access to upper floor classrooms, laboratories and offices.

These examples served to remind us that community college planning is not yet limited to established rules. The handbooks haven't been written. New ideas are welcomed; innovation is in order; this new American education invention is still evolving. ■

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Technology And Its Potential For Educational Facilities Design

As an architect, I like to think that I am a somewhat creative person. And I wish I could come to you with fresh and highly original concepts. But, in fact, it has been a rare occasion indeed when I have had an original thought worth exploring, that in research, I did not find it had been born long before and was pretty well documented.

So I have borrowed freely in formulating my remarks, and if there is anything new, it will be in the context or sequence or the emphasis I put on what you probably have heard or read before.

I regret that I have not been able to attend the other sessions so some of my material may be a repeat of what has already been covered. As various panel sessions are devoted to specific areas of technology, I have tried to hold to the broad aspects of its potential in terms of urgency and direction.

Notes on Introduction

We are ending five days of addresses and conferences devoted to technology.

Why have we such an appetite for an old term, so overworked, so all-purpose, so abused, that it has fallen into the family of wornout cliches that tend to turn us off, not on; vogue terms such as, "Component," "Systems," "Generation Gap," "Confrontation," "Activist," and, perhaps, even "Miniskirt."

If the word Technology on the masthead is impressive at all, it is because we are aware of a great ground swell of change that is upon us, and of a consequent wave of new and better technology, the partner of change.

Whether or not we agree with many of the prophesies heard at this convention, we are encountering a wave of technology that is generating influence, and to a degree, will direct, the ebb and flow of programs and structures and the social development that will occur in our times.

The form of the programs and structures, and how they will function, and the course of our existence, will be greatly influenced by how much of the change passes through the creative mind that will give insight and direction to the new uses of technology in the years ahead.

We discuss it here because it is a hope, a way out of chaos—a major ingredient to the solution of problems which confront us.

Western civilization has been built on an attitude that man is the dominant system—that he is the ruler of a world designed to serve his goals at whatever expense to nature or pollution of its resources.

Until recently, he has not evaluated the consequences of unlimited reproduction of his kind on an eroding planet.

Until recently, he has not abandoned his frontier philosophy—that when he has worn out his environment he can abandon it and move on.

Cold, hard reality is forcing a search for new concepts. We are confronted with change—more drastic and sudden—and of greater scope than has ever been encountered before.

The only certainty as certain as change is man's resistance to it. As it has always been, any interference with the status quo is likely to be challenged, disparaged, and often violently opposed.

Social and technological change is a continuous and stimulating force, most welcome to a degree. We want it, however, to come gradually, not to be force

fed. We want to be given due time to absorb it by a sort of mental and emotional osmosis. There are times, though, when it doesn't come that way. The build-up of pressures becomes too great, an explosion occurs, as is happening now, as it has in the past in time of rapidly changing values.

Christ advocated change, gave us Christianity, and was crucified for his effort.

Galileo advocated change and was committed to the dungeon by the leaders of the church founded on Christ's teachings. They preferred that the earth be flat and the center of the universe.

Lincoln advocated change and was assassinated for his conviction that slavery must be abolished.

Margaret Sanger advocated change and although even now many consider her a disciple of the devil, new attitudes on birth control have been set in motion.

Martin Luther King advocated change, and his assassination may accelerate, rather than deter, the changes he sought.

There is ever evidence that drastic change is in the making and will occur rapidly. There is also evidence that this so called threat to the social and technological traditions we have so carefully and slowly built will encounter a full measure of opposition.

We, in education and architecture, are at a period when we will be tested, be forced to evaluate and to make use of every available resource.

The potential of technology for education and design in our time hangs in the balance between general acceptance and rejection of traditional concepts in areas over which we have little control, for our fields are component ones, reacting to signals emanating from the total system.

Any evaluation of the technological resources that will be available to us, and their potential, must be related to the causes and pressures which encourage their development and use.

As each of us may evaluate, with varying emphasis and assumptions, the causes and pressures, we may arrive, with equal logic, at different conclusions. My conclusions stem from the following factors which I believe will force both education and the design of buildings into new territory.

1. The American drive toward equalization of opportunity for all of her people.
2. The acceleration in population increase.
3. The factor of "time."
4. The factor of "new mobility."

There is today working in America a fundamental drive for equalization of opportunity for all men; equalization for men in terms of their economics, their education, and social and racial status.

The old saw that the "poor get poorer and the rich get richer" might today be appropriately reappraised in terms of "the poor get richer and the rich get poorer," at least in a relative sense—for to elevate the great mass who have less, there must be a disproportionate taking from those who have more, with all the implications of vast central government programs to come.

It appears to me that our society has determined that it cannot afford, at any price, the slum, the poor, the undereducated, the socially-excluded.

This drive to change the status of great numbers of people translated into terms of programs and facilities will change the "name of the game" for those of us involved in education and its architecture. The new name is "More and Better."

The new game must involve advanced technology in—educational techniques, methods, programs, and the type of facilities we will be asked to design.

The implications are enormous.

Population Increase

If we add the factor of acceleration of population increase, then the demands for advanced technology are multiplied.

The term "population explosion" has become one of those outworn cliches I mentioned earlier, but it cannot be discounted as a factor in forcing the development (and use) of more and better technology in education and building.

Three hundred and twenty million people are destined to live in our metropolitan areas within our time. One-half of these will be under 25 years old. We may discount, if we wish, these figures—it won't matter much. In any event, the increase in urban population will project us into new and unexplored areas of programs, designs and construction.

The total number of people that must be served is beyond the capacity of a society which has no comprehensive plan for providing "Better and More" in either education or the facilities that will be required.

Any education is only a portion of the total burden which includes housing and all other service to the needs of the new millions. In fact, at this time, I am not aware that we have developed, as yet, even viable programs for stemming existing urban decay.

It would be convenient to think that we can satisfy the projected demands with conventional methods and techniques, and more and more of the same.

It would be more realistic to believe that this is a sort of fantasy and a road to chaos.

The population explosion then, in itself, imposes a compelling need for the rapid, creative development and application of new concepts and technologies if the problems are to be solved.

And this implies a need for a radical change in our thinking, and there is urgency to the requirement that we all get busy at it now.

The Third Factor

If the first two assumptions are valid, then the changes cannot come slowly. And, an embrace of new concepts and technology must come without delay.

This will impose that we be able to initiate, and experience much that is new to us, that is different, without waiting for the test-of-time. That we gear to accept radical change faster than has been required of past generations, except in times of total war. Conventional programs and methods lack the elements of speed and flexibility that we must have to win the race.

If, however, we are not politically and morally committed to the equalization of all of our people—and if we do not accept the prophesy of great population increase within the next twenty years—then there is less need for the readjustment I have mentioned in terms of time. But there are still other factors.

A Fourth Factor is mobility

When the prototype of the red brick schoolhouse was built, transportation was by means of foot or horseback. Many people never ventured beyond their visual horizon. In general, it was a stay-put society. The farmer's boy and

the banker's son alike started and completed their education in the same community and school buildings their parents may have attended.

In America today, every three years the entire population relocates. I have read that approximately twenty-five percent of our electorate may not be able to vote this year because they are so on the move that they will not have established voting residence. A surprising percentage of our people live in "mobile homes."

We have entered into a new kind of life, that of a "mobile society."

So education is now serving a shifting body of students who are regularly uprooted and are without an identity of place, and often without an identity of direction; students who will probably shift from one school to another on the average of every three years or less. The needs of students without a base are different from those who went to the "red brick schoolhouse" of the past. The educational programs and, consequently, the facilities must be readjusted to their needs.

This, then, is a very appropriate time for us to examine the tools that are now available, and also the gap between our present capability and the capability which we must develop. And it is the time for a general reappraisal of the potential of existing techniques and their limitations as well.

Educators are faced with increasing enrollments, faculty shortages, expanding subject matter, and insufficient financial support. The stresses have generated strong reactions and a search for solutions.

These stresses have also been instrumental in creating the ground swell of interest in innovative programs—in the adoption of new methods and techniques, ranging from curriculum reform to the manner of presentation of all educational material. There has been much probing into the mystique of learning, re-evaluation of the needs of the student, and the very objectives of education itself are being reappraised. Educators, in turn, are re-evaluating their architecture. The great resource of knowledge and technology now available is well ahead of any broad commitment away from the conventional.

A fifth factor is the moral obligation to build economically. We have touched on but four of the causes and pressures that stress the need for new and better technology, and there are, indeed, many more.

Even though there were none, it must certainly be our obligation to provide more and better education with housing compatible to its needs, with every economy consistent with the values that must govern.

As educational programs seek their complement in new facilities, the potential economy of automation and new technology in construction cannot be disregarded.

More and more sorting pens, where children play musical chairs when the bell rings, are still being designed and constructed, as inflexible as ever by the double-loaded corridor mile. They are built from habit more than from any other consideration.

In terms of the future, they are buildings without versatility, with built-in obsolescence, ill-suited to any recorganization of education or to commitments beyond the comprehension of knowledge, and into the more sophisticated objectives of application, analysis, synthesis and evaluation. They are buildings incompatible to the efficient use of learning devices, or to the technology of automation—rigid buildings—unnecessary anachronisms in a period of change.

Facilities that do incorporate new knowledge in the technology of education, design and construction—all three— are rare indeed, and the three are complementary. The lack of any one will reduce the potential of, or may defeat, the efficacy of the remaining two.

As I have indicated earlier, there is little or no excuse for the design of any new educational facility, from grade school to dormitory, that is not sufficiently versatile to accommodate both immediate and long-range programs as they evolve. To build correctly is the essence of architecture, and to build correctly now, design must not be blind to the forces of change.

The Technology of Design

There are new dimensions to architectural design—dimensions related to people, behavior, and the multi-sensory qualities of space and environment—dimensions related to human values and to the disciplines of new technologies.

There are new demands on the designer that obligate him to stay abreast of the technologies that are available to him and which are not necessarily limitations to the architect's creative drive for variety and good design, as is so often argued. Nor would they lead to the stereotype, or to design conformity, or to sacrifice of grace and beauty; but on the contrary, they would add to his creative opportunity and free him from the burdens of routine detail. There are gains in economy of effort, cost and speed of construction, and in the designer's opportunity to create facilities that are vivid and exciting places in which to teach and learn. Architecture can nurture and advance the educators' objectives in many ways.

For example: Solutions should be sought that will avoid the adverse behavioral patterns that often develop in the "nod-line" of crowded, institutional corridors, faced with hundreds of lockers. There is no architectural reason that, during the occasions of class change, students' time should be sacrificed to bleak monotony, aesthetic and human benefits aside, there are persuasive economic arguments that the elimination of corridors, in favor of open space, can save substantially in total square feet required.

While open plans have not been universally successful, the failures can generally be traced to misapplication of purpose or inadequate investigative procedures and failure to use advanced technology as a resource.

The general opening up and freeing of interior spaces can generate many benefits, from the strictly academic, to the subtly psychological. On the other hand, designs that do not go beyond the use of conventional methods and techniques are prone to defeat needs for privacy, control, definition of use, and freedom from distraction.

The cause of distraction in fact, is not, as commonly assumed, noise and motion as such, but rather, the intrusion of anything unexpected and foreign to the environment. Silence, not noise, is distracting when it occurs suddenly.

Traditionally, we have sought to wall-off distraction and wall-in privacy without seeking alternatives.

Often a more satisfactory sense of privacy and a better environment for learning can be obtained at a well designed carrel, located in an open area, than would be experienced by a student at a desk in the confines of a closed room.

The quality of a controlled ambient

noise level to mask distracting sounds, aided by acoustic dampening on both floor and ceiling, and the use of multiple low volume speakers, in place of the high amplification required if only one unit is used for audio-visual presentations, are all factors that come into play in the design of free space.

Among the benefits to be found in open planning is the greater opportunity for interaction of the related activities within an educational program. Solid partitions do not favor transitions from small to large groups and tend to limit variety, size and versatility of the instructional areas so often requested by educators today.

The standard closed door, 30 x 30 classroom, in its cloistering of students with a single teacher, has probably done more to impede the implementation of progressive interaction programs than any other single factor. Traditional buildings have placed a heavy burden on change.

Even the most perfect of open plans may be programed into failure by the educator. Like all tools, their service to the user is dependent on his know-how and skill.

New facilities must be designed to accept new installations of unknown variety and kind. The mechanical and electrical components required are of ever increasing complexity.

If these components are not to stand in the way of future change that may be desired in the structure, design must provide for alteration of existing services and addition of new ones without destruction to other elements of the building and without shut-down of the plant. Concealment for aesthetic reasons of mechanical service runs and connections, must not be done at the expense of access to them. While the type of versatility I refer to is difficult to achieve by conventional means, it is a concomitant of the component systems approach.

There is a fundamental requirement that educational facilities have the ability to ease the transition to improved education and be appropriate to both today and tomorrow.

An enormous mass of technological resource is available, and it would be difficult to conceive of any type of structure, or condition, that could not be achieved within a designated period of time. Present technology is sufficient to provide classrooms, or laboratories, on the ocean floor, or in outer space. Anyone who has thumbed through LIFE Magazine has seen, from the pictures, that these facilities have already been fabricated and used. The students are in these cases, of course, astronauts and oceanographers.

Predictions Come True

A century ago, Jules Vern predicted the landing of a rocket on the moon from a base in Florida. Far fetched then, but a reality now. **We can't stop the world—but we can get off.** Deportation to the limitless frontiers of outer space might be an intriguing alternative, depending on how you look at it. We can all think of someone who should go.

Surprisingly few concern themselves with what is not only possible, but with that which can be practically and economically achieved within our own areas of endeavor.

As to the potential of technology to decrease the time of construction, it is of interest to know that given a few weeks for the installation of underpinnings and mechanical and electrical services, traditional classrooms could be installed, fully equipped, air-conditioned, ready to use, at the rate of thirty or more a day.

Although a school is not a hostelry, I would call your attention to the hotel that Zachary built in San Antonio for the opening of Hemisphere. As Hilton Hotels go, it is a superior and beautiful job—20 stories high—about 500 rooms. The entire building required eight months from idea (before a line was drawn) to occupancy, a remarkable achievement, in itself. Of even more interest, however, is that rooms were installed, ready to use, at the rate of 36 per day, including entries, closets, balcony, bath, towels on the rack, ash trays on the tables, and clocks by the fully made beds. The rooms were prefabricated and fully furnished on the ground, hoisted in place. The air conditioning and electrical connections were plugged in. The only other requirement for occupancy was to unlock the entrance doors.

The computer, automation, new design and erection technologies used to produce the hotel have proven that the speed of design and construction can be greatly accelerated.

These same processes are equally applicable to the construction of educational facilities, although they must be applied to entirely different space requirements and demands for flexibility.

Under the egis of E.F.L. some six years ago, the results of Ehrenkrantz' development of the SCSD Component System were published. The System has been widely used in educational and industrial facilities.

SCSD pointed the way for the development of many subsequent systems, all based on a similar performance specifications approach.

One of the most recently developed systems that has progressed from initial interest to R & D and on to fact, is the Toronto System established for their forty million dollar school building program.

On the basis of the apparent success of the Toronto project, the Canadian government is now programing component systems projects involving some five hundred million dollars of construction cost.

Technology is a way to higher performance and speed of construction without corresponding price increase. New technologies of systems design and construction are being applied to hundreds of projects, large and small, and their greater use is limited only by the general lack of knowledge and ability to design within systems parameters.

There are also many projects that reputedly involve a systems approach, but in fact, ignore the multi-disciplined coordination and interaction of elements that are implied by the term "systems," and without which only modular repetition and standardization of units is obtained. Standardization is a single element of "systems," just as the movable partition is a single element of "flexibility." These misguided attempts have served to confuse and dilute proper evaluation of the true component systems concept.

On-site, hand crafted construction methods cannot compete with automation. In the long run, the demand for speed, versatility, interchangeability, quality control, economy, and many other salutory factors will direct most construction to involvement with new technologies. Those applicable to educational facilities will be in the vanguard.

Future progress will of course relate to negotiation with unions on jurisdiction, political coordination in redevelopment of codes and regulations, and of financing. There are many examples of successfully completed projects to

indicate that there are no problems that are not subject to solutions.

Witness the new, single family, instant-housing announced by Mayor Daley and the Chicago Housing Authority. When weighed against the city's established building codes, union jurisdictions and normal financing procedures, it is as improbable a project as one could imagine.

An over-riding need, plus automation, have spawned this commitment to erect 2,000 or more pre-fab, modular units a year, for sale to disadvantaged in the Windy City. All barriers were removed when the Mayor, the unions and industry, found a common denominator. Two million dollars of union funds have been committed to the building of a prefabrication plant. The U.S. Gypsum Co. is furnishing their products. City Hall has not allowed building codes or regulations to stand in the way.

Any private projects, using new technologies, have gone forward with equal success.

Temporary but indisposable

World War II brought an acceptance of the concept of temporary buildings. Some twenty years later, many are still with us. They were not so temporary as to be disposable which at some point they should have been. Research is now being applied to the technology of disposable buildings for housing and for education buildings of polyester resins so easily installed and inexpensive that they may be literally thrown away. They would be constructed of interchangeable parts, and could be disassembled and reassembled to the dictates of new needs. Throw-away architecture may sound abhorent, especially to an architect, but it may have a real and important place in the evolution of special-use facilities of the future. In any era of radical change, it may be entirely possible that "disposable" facilities will more accurately reflect the needs, than the "temporary" ones, with their habit of lasting too long, or of permanent buildings when equaled with obsolescence.

We are all familiar with the wealth of teaching devices now marketed and widely used.

We have not, however, reached the time when most information transactions with the student may be negotiated through terminals located at home, in dormitories, or other stations remote from where the information is stored; when laser beams may record thousands of pages of material on a single sheet.

Nor when we are at the outer limits rather than at the beginning of a computer age.

Against this potential of technological progress, who is willing to accept the burden of prophesy? Who can accurately predict the programs or facility requirements of the future?

We don't need to wait in order to provide buildings that are adaptable, within reason, to coping with the probable and even barely possible future and yet not be so inappropriately "flexible" that they are shapelessly unresponsive to immediate needs.

I believe that we are all basically aware of the revolutionary changes in education, of the urban crisis, and the need for advanced technologies.

In 1952 and before, workshops were being held on these subjects and many articles have been published. There has been wide dissemination of the results of subsequent research.

The prime objective is to eliminate the senseless repeat of factors outmoded by advancement of social and educational reform, and to discover, understand and use the technologies that will lead us to accomplishments—faster, better and more.

In this age and country of the most rapidly developing technology the world has ever known--where industry is revolutionizing its techniques every few years, the technology of building lags far behind.

Even so, there are far more resources available to us than we seem willing to use. ■

DR. J. LLOYD TRUMP
Associate Executive Secretary
National Association of Secondary School Principals

The Impact Of Technology On Education

As we approach the 1970's, we ask ourselves, What is going to happen to education in the next decade? Are schools going to make the changes they so urgently need, and how are they going to change? Is it possible for us – in this marvelous business that we are all in together – to take these innovations and examine them to get the underlying reasons for them out where we can take a hard look at them? Then we can see if these purposes are actually being brought into the schools and fulfilled by our innovations.

We must clarify the values we are seeking, we must stay with them long enough and evaluate them with such care that we will in fact basically change teaching and learning in the schools. And we will change it in accordance with an ideal that is very old. You see, the premise, the background for all these innovations that you are building, the operable walls and the resource centers and all these uses of technology, has been with us for some two thousand years or so.

Consider, if you will, a favorite quotation from Quintilian, written in 89 A.D., nearly 1900 years ago:

"Moreover by far the larger proportion of the learner's time ought to be devoted to private study. The teacher does not stand over him while he is writing or thinking or learning by heart. While he is so occupied, the intervention of anyone, be he who he may, is a hindrance."

Those were great ideas in the first century, A.D.; now we're talking a lot about them today. One of my main goals in life has been to reduce the *quantity* of teacher talk and to improve the *quality* of what was left. Then youngsters would have more time for independent study.

The question is, Will we ever be able to get independent study into the schools? And a prior question is, can we ever get principals, teachers, superintendents, board of education members, parents, and architects to understand what independent study aims to accomplish? We have written about it extensively. But, you see, people do not read carefully; they do not even listen very well. People read what they want to read and they interpret what is said as they want to hear it. The problem of communication is getting someone else to hear what you are really saying and not interpret it in his own way.

We have recently received another foundation grant. There's no news in that. But I mention it because in the next six years or ten, (the grant now only runs six years), we are going to put together all that many of us have been talking about–an entirely different staffing pattern for teachers, an entirely different schedule for pupils, entirely different methods of spending money, an entirely different concept of a school building–to make everything that we know work together. We are going to do this in seven different schools plus some associated schools. We deliberately are holding the number down, because we want to work very intensively with these schools. The grant is from The Danforth Foundation.

First, we will reshape the outlook of the administrative supervisory hierarchy, and especially the person who matters most, the school principal. These principals are going to have an entirely different life. To begin with, we are going to get them out of the office down by the front door where they can be bothered all day long. The principal's office needs to be placed with the offices of the teachers; and incidentally, we are going to build some respectable offices for the teachers.

These principals are going to spend three-fourths of their time working with teachers on the improvement of instruction, because nothing will be different in the schools until the teachers are completely re-educated–brain-

washed—to get rid of the unfortunate preparation they had in their universities and give them an entirely different concept of the role of the teacher. We are going to work with these schools until they incorporate all we know about how schools should be run. We will evaluate carefully the effects on principals, teachers, pupils, building use, and the use of school funds.

Now, I just want to describe very briefly tonight what these schools will be like so that you can begin to work on the settings such schools call for. The conventional school building needs to be drastically altered. Let's talk about the teachers first of all.

Incidentally, if, after these remarks tonight, any of you want to look at this further, write me and ask for a paper, "Needed Changes for Further Improvement of Secondary Education in the United States." May I hasten to add that everything this paper says about secondary education is equally relevant for elementary or primary schools, and for the universities. Of course the universities need the changes more than anyone else, and the secondary schools next. The elementary schools always have been the best, especially kindergarten and the first grade.

I am going to talk to you about the role of the teacher in these secondary schools that we are going to be developing over the next decade. The typical teacher (not each one, because we are going to recognize individual differences among them) will have only three or four preparations and presentations per week. The purpose of these presentations, unlike most teacher talk today, will be three-fold and specific. The most important one is to motivate, to get the youngster interested in what the pupils are supposed to learn. This will be accomplished in 30 minutes per week, because if the teacher talks much more than that, the students will get more than they want to hear, and the motivation goes out the window. We say to teachers, "If you want a youngster to read a poem, for goodness sake don't **you** read the whole poem. Read the most exciting line or two from it and maybe you'll hook him so that he will want to read it; and so it is with everything else. Give them the appetizer, not the oversized full course."

Once a week, therefore, the teacher will talk in the subject area to motivate the students, to give them information that may not be available elsewhere, and to suggest independent study activities. However, this presentation is not locked into what the pupils do in their independent study. Its purpose is simply to give them a shot in the arm, to get them working, and to furnish a sense of purpose. Usually the presentation will deal with the present scene because that is what the kids are interested in, the here and now. (Today they tune out so frequently on school because it doesn't seem relevant to their present lives.) So this teacher prepares one or two such classes per week.

If he gives four presentations a week that's two hours of his time. Then for another seven or eight hours, requiring no preparation, this teacher sits in and listens to a group of 12, 14, or at most 15 pupils who are discussing something in the area they have been studying or something that was presented to them, or whatever they want to talk about. Basically they are learning **how** to communicate with each other, to talk, to listen, to respect each other's ideas, developing sensitivity, all of which is absent or largely overlooked in most secondary schools today.

The teacher's schedule, then, is ten hours, at most, the typically 8 or 9 of scheduled class work out of the 30 hours that the teachers will spend on the premises. Thus the teachers have 20 hours per week for their other roles, one of the most important of which will be to serve as a teacher counselor. One of the unique developments in these schools is that every pupil will be known as a **total human being** by somebody in the school. That doesn't happen today. One of the contributing factors to student unrest, underachievement, and the like, is that no one knows the kids. We have these counselors in their so-called cubicles. Their assignment typically is to sit in a small office where the counselor can talk to every pupil once a semester to persuade him to take more science, mathematics, and foreign language, where to go to college, and so on, all of which could be handled better by large-group instruction, independent study (programed technology) and small-group discussion. The point is that even if you have one counselor for 270, he doesn't know the pupils. He just has a little card on each that he pulls out. Even in these so-called affluent schools with 25 pupils in a class, the teacher who has five classes a day can't know that many. Of course, they know the pupils' names and a few little things about them, but they don't really know them.

These teacher counselors we're talking about will be responsible for knowing 35 pupils thoroughly. The same teacher will stay with the students assigned to him during all the years they are in the school. However, that doesn't explain how he gets to know them. They don't meet the kids daily in a homeroom, a waste of time for both teachers and pupils. There will be no home room meetings. There's no reason for these teachers to meet the 35 in a group, because you don't get to know them that way. They will collect information about their 35 pupils from all the other teachers. There will be evaluation drives around the school. For instance, for two weeks the school will be concentrating on examples of creativity, observing the pupils and writing the pupil's name and an example of his activity on a 3 by 5 card. Then these go to the teacher counselor so that the teacher knows that of the 35, 27 of them did nothing creative during the past two weeks that anybody saw, while one of them had 12 cards. This is the kind of evaluation we'll be looking at. Other examples would be how pupils apply what they had learned to a new situation or developing responsibility for his own learning. The teacher counselor will have all kinds of information about his pupils. He will also make up the pupils' schedules for their independent study.

Yes, technology will come in the picture. We'll use computers and retrieval systems to keep more information about pupils than school personnel today can write down on all those forms, or keep in their minds, or in their class books. We'll have a lot of information that can be retrieved, which is good use of data processing. (Most schools are using data processing to do faster what they should not be doing at all.) I am against data processing in scheduling, in printing off report cards faster—the same old report cards—printing the grades faster—the same ineffective grades—or the same ineffective attendance procedures.

So the teacher counselors will know these youngsters, and when Mama or Papa come to school and want to talk to somebody who knows their child, they'll find somebody who doesn't have to pull out the file, who can sit down

and talk to them and tell them how their child is getting along. The other aspect is that the professional counselor is available. He is in the office 20 hours a week. Well, he doesn't need to stay there all the time, but he is usually available.

Now, to return to teachers. In their unscheduled time they will keep up-to-date, improve evaluation methods, and confer with individual pupils and colleagues. They will supervise the instructional system, but they will not babysit in a resource center because that is a waste of teacher time. We have babysitters in homes to see that the children are there, watch them, and keep them from wrecking the place. The parents leave a telephone number where they can be reached in case of questions or an emergency. Now we're going to have people like that in schools, trained in the subject area, babysitting in the resource center. We call them instruction assistants.

I put out a mimeographed paper more than a decade ago, and then published in "Images of the Future" in 1959 exactly the kinds and quantity of assistants that teachers need. No one has adopted this approach anywhere but it will be adopted, in precisely the manner described, in these model schools. For **each teacher** there will be 10 hours per week of clerical help, 20 hours per week of instruction assistants, (for example, 36 teachers in a school would have 720 hours of instruction assistant time of persons who are knowledgeable in the subject field who will supervise the independent study of pupils) and 5 hours per week of general aides, (people who do not have secretarial training or training in the subject field to put things out and return them to the shelves and look after youngsters in the canteen lounge and conference areas).

That is what is going to happen to teachers. Now you're going to have to build places for them, with offices and workrooms for them and their assistants.

But, let's move quickly to the pupils. Each pupil's schedule is the assigned responsibility of his teacher counselor, worked out before school opens in September. Once a week, the pupil will attend a presentation in each of the eight areas of human knowledge. This goes for each year that he is in school. For instance, he will attend a presentation in the fine arts and in the practical arts. These schools won't say, as most schools do today, that only two types of persons take art, music, or practical arts after the eighth grade in junior high school, the very talented, and the ones without talent—who can't succeed in math and science and they don't know what else to do with them. We're going to recognize that human beings need continuously to be kept up to date in the fine arts, the practical arts, the sciences, the social sciences, mathematics and all the rest. There's a curriculum job to be done, and I won't go into it in detail but simply hint at it.

Every week, the pupil will attend one presentation in each of these eight areas. Each of these presentations lasts 30 minutes so that's only four hours a week listening to teachers, which will be quite a novelty. These teachers have prepared. They're going to be about as exciting as the best on television or the best on a movie. The other part of the pupil schedule, you remember, is for each pupil, once a week, to meet with 12 or so other pupils to have a discussion about the fine arts, the mother tongue, or one of the other six areas of human knowledge. He will attend a discussion session for each area. Eight hours of the conventional 30-hour week is scheduled for him. He has 20 hours left for independent study.

Independent study, as I define it, is what the pupil does when the teacher stops talking. As such it becomes the heart of the program. It is for everybody at all ages, for young children, as well as university students, for the very limited as well as very talented. It is where the **pupils** cover the subject. You see we are going to get over the idea in the schools that the **teachers** orally cover the subject in presentations and recitations.

The teacher's goal is to get each pupil to do some independent study but the teacher will recognize the fact that in spite of his most stimulating presentations, some youngsters aren't going to care much about the mother tongue, English. They don't care about Elizabethan literature and the wonderful thing is that they don't have to.

You can live a very full life without loving Shakespeare or ever having read Silas Marner or a lot of other things. On the other hand, there will be some youngsters who will be so fascinated by Silas Marner and Elizabethan literature that they'll spend ten hours a week at it.

By now some of you are thinking that independent study is unstructured, roam-at-will time. I never said that. I don't believe that. I think every youngster should be under adult supervision where attendance is taken. I shudder at computer-based schedules that dump 300 pupils in a cafeteria for independent study and if they don't like it there, they can go out on the school grounds and loaf. Then some parents complain, and then the school system says we tried independent study and gave up. They didn't even understand what it was in the first place, just as some of these people responsible for these computerized schedules don't understand what independent study is all about. They talk about open campus and things like that. Perhaps a few people, but not many, may be permitted to move around without supervision.

Another thing about independent study is that a lot of it doesn't take place on the school premises. Where was it written that all learning takes place in a thing called a school building? I had a wonderful experience as a high school kid way back in the early 20's when vocational agriculture was new. I was a vo-ag student. It was a small school and they had to get enough kids to get the federal money, so we all took vo-ag. We started this program in the basement of the school building. You architects will be interested to know, if you haven't studied it already, that almost every good thing came into the school building by the basement. When they cut out those small buildings outside with the holes in them and brought them into the schoolhouse, it was through the basement first. Ultimately, the restrooms were sufficiently accepted that they moved up higher in the building. Well, we started vo-ag in the basement. There was nothing in the room. We built the tables because the teacher was a smart person. We had four pupils, each one seated at a table. Now they call it team learning. The teacher didn't talk to us much, but the most wonderful thing of all was that we didn't have a simulated cow there. When we wanted to study cows, we went out where the cows were, and the same way with cornfields. Each of us had a project. Some of you know about vo-ag. We kept track of it, we made money on it, we reported on it, and the teacher was out there with us. We were away from the school a lot of the time.

One of these new model schools I've referred to, and maybe more, will have the finest vocation education program in the country and they won't have specialized machinery in the building because the pupils will learn where the action is, in offices, shops and factories for work experience, in libraries and museums and governmental offices and welfare agencies to study the social sciences where they exist. As you see, this concept of independent study is a very broad one. It has a considerable relevance for school buildings.

Now before school opens in September the pupil schedule had eight hours per week fixed by the office. It left 20 hours to be scheduled by the pupil and his teacher-counselor. Every one of those hours is filled in. For example, a pupil says, "Well, I'm going to be an auto mechanic so on Tuesday and Thursday I want to work in a garage or filling station." (The school has made arrangements for that independent study; the supervision is by a mechanic approved by the school but he doesn't have 18 semester hours of education nor does he need them. The person in the school handling the practical arts goes out and looks over the situation periodically. The supervisor and the mechanic out there report to the teacher-counselor about the attendance and progress of the pupil.) Then the pupil says, "I want to spend six hours a week in the art resource center," so that is put down. And so on, the whole week of the pupil is scheduled.

Two weeks later, the youngster gets tired of something he scheduled and wants to change it. It can be changed anytime. The schedule is no longer locked in the principal's office, nor is it locked away, which may be even worse, in a computer-based schedule. It can be changed anytime, for a good reason.

If the teacher-counselor and the pupil can't get together on the schedule, there is appeal to the professional counselor (who is now working as a counselor should, with the teachers and pupils, making himself available to them if they have problems). After the counselor, there is a possible appeal to the principal, and I suppose ultimately to the Board of Education, if the youngster and the teacher-counselor can't get together.

The curriculum, of course, is very different in these schools. We're going to attack the problem of deciding what is **essential** for everyone in all of these areas and separate the essential from that which is **relevant** and **important** to those who have special talents and interests. We'll thus get rid of much of the required content. Today's curriculum is dominated by the college professor who looks upon these school children as potential professionals in his field, as if every youngster is going to become a professional writer or a professional interpreter of literature, or a professional speaker. Most of them are not going to be that at all and they don't need that kind of training. We will analyze each youngster and develop an individual program for each one.

A part of the school building as we are planning it, (which is only about half the size of these needlessly large structures that we presently build which cost so much money) will be busses. The school is a docking place with pupils being shuttled back and forth between headquarters and the learning resources centers in the community.

The building itself is made up mainly of different kinds of resource centers in all the subject areas. These are subject-centered resource centers. For example, there is a center in the English language arts where the pupils read, listen, view, write, think and so on; it has also a place where the "tools of the trade" in the English language arts are; typewriters, a place to build models, etc. Every center has its own special equipment. These centers are not large places. I am horrified by these massive resource centers that are built in schools, and even more horrified when they insist in putting the teachers' offices in the same place. (One of our goals is to get the teachers away from the youngsters. If you make the teachers too accessible, then the youngsters line up outside their doors. Pupils don't really need to see the teachers often. But they've been pretty well brainwashed. If you go in and talk to the teacher often enough, a pupil believes the teacher will raise his grade by at least one letter. Practically all of these questions can be answered by the instruction assistants, who are sufficiently qualified in the subject to know when the youngster has to see the teacher. A wonderful thing also about this arrangement is that the teacher is usually available because his schedule allows him to be.)

These massive multi-subject resource centers don't look like anything except a big room. It is hard for the pupils to find things. The room is uninviting: it doesn't look like a science place or a social science or a fine arts place. Moreover, it is hard to supervise the big room. There shouldn't be more than 30 or 40 youngsters at most in a resource center at one time. These centers need not be much larger than the conventional classrooms that you're still putting in the buildings, (though I don't understand why).

There is also a library in this school but the library serves an entirely different function. The resource center is where the pupils cover the subject or that portion of it which the school says is required. The library in contrast houses the materials for pupils engaged in depth study.

The librarians are worried. I was in a brand new school just two weeks ago. The librarian said, "You know what I'm worried about? I have to duplicate in this library everything that is out in the resource center." I asked, "Why?" She said, "Well, I don't know. Won't they come in here and want to find the same stuff?" I said, "I hope not." So we talked. She does **not** need to duplicate anything that is out there in the resource centers. Her's is the advanced stuff. Now, she too gets out of the library cubicle because her responsibility takes her all over the school. This library is smaller. Last week I told this story in a public meeting of librarians. A state supervisor of libraries was there. She said, "We want large libraries," and I said, "We know. You're empire builders just like the physical education people and some of the others. The library should be small. If it is a big school, have two or three of them."

After the meeting a number of librarians came up to me and said, "I'm glad to hear somebody say it. I have one of those monstrosities as large as this room or bigger even. I'm worn out just from walking around." In these big libraries pupils can't find things easily even with the Dewey Decimal System. You know, we ought to make things easy for youngsters, not tough.

Now, I'd like to talk about rooms for teacher presentations. I still see auditoriums being built by people who obviously don't want to see or hear well, because they still build the floors with just a little slope, so you're always looking around the person in front of

you. I've been in new auditoriums built so when you sit on the side, you look straight forward into a wall. The stage is in the center. That is why you should never build a so-called team teaching facility. Then you're stuck with this room for large-group instruction. Usually the wall isn't very high and apparently nobody ever thought that they were going to use an overhead projector or other visual aids so there's no place to use them. Let's build a room that is designed to make a positive contribution to the presentation, i.e., everything centers on the presenter.

The best auditorium that I know of—well, I've seen one or two that were about as good—was built in Gary, Indiana in 1926. This auditorium seated a few over 600 people. You entered it from the third floor, the second floor and the first. There was no balcony. Everyone had an unobstructed view of the stage because of the slope. So, I say, build a room for presentations—not a multi-purpose room or a team-teaching room. Plan to use modern technology in it.

The needs for small-group discussion are different. In an article called "School Buildings for Modern Programs" I described it this way:

"Some imaginative architect might build a small-group discussion room, circular in shape, with a domed ceiling that psychologically pushes the group together, air conditioned, with controllable light, and soundproofed. Such a room would foster the educational objective through a positive climate."

For small-group discussion, two hundred fifty square feet is large enough. Yet, people try to hold small-group discussion in open spaces. Well, when you're discussing around a table and trying to draw everyone in, and somebody is talking nearby, I don't care how much carpet you have on the floor, it doesn't work. You find yourself looking over to see your pal in the next group. (Incidentally, you don't want a window in this room either, nor do you have them in the presentation room. You do have them in the resource center. Let's use our good judgement about where to put glass and where not to put it.)

In these model schools, we're going to spend money differently. The building we're talking about will cost less. We will spend what we save on technology, buses, and arrangements for independent study in the community. We will utilize spaces differently. Some of these schools will be remodeled in accordance with needs as they develop.

Certain general developments in the school building are needed. First, sound control. There is a good deal of movement in this new school. When pupils are tired of reading and they want to listen to something, or hold a conversation, noise will occur. This means that carpeting and acoustically treated ceilings are highly desirable. In some instances, acoustical treatment of walls is essential to improve listening to recordings.

The sound system in any facility used for large-group instruction needs a large number of speakers so that students can hear well and the tone quality is good.

Light control is another requirement. Too much glass is used in most school buildings. Recently they have been cutting down on the amount of glass on outside walls and then using a lot of glass on inside walls. It is just as disconcerting to see students moving around on the inside as on the outside.

As for artificial light, one suggestion is to have dimmer switches in the large-group area to make it possible to control lights. Some of the independent study areas need high intensity lights, others not so bright.

Comfort also means temperature and humidity control. That is why we need year-round air conditioning in most places.

One good way to save money is to reduce corridor and lobby space. Let us move in the direction of compact buildings. We can walk through cafeteria areas and independent study spaces, if these are carpeted, and thus reduce wasted space. As we make the schedule more flexible and students are not all moving at one time, the need of large corridor and lobby areas is lessened.

Multi-purpose space is costly in most instances. Conversely, economy requires avoiding unnecessary specialized spaces that are not used all day. That is why I like auditoriums with operable walls. It is why in a smaller school you can combine some of the resource centers, in English and social studies, for example.

You might say I haven't really talked about school buildings and technology. No and yes. No, because many others in the conference have dealt with technological developments—also, you are the experts in translating ideas into buildings. On the other hand, everything I have discussed is going to make your challenge different in the decade ahead. That statement does not imply any criticism of what you and the school people have done in the past. In almost every speech I make or every article I write, I state that nowhere in the world have so many been educated as well as in the United States. And I have worked abroad enough to know that statement is true. The very superiority of this school system has been the constant search for better ways. I am absolutely amazed at the changes that have occurred during the past decade; but those changes are going to seem small indeed, as well as sometimes poorly conceptualized, compared to what is going to happen in the decade ahead. You builders of schools are going to have a tremendously significant role in these changes. ■

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